HEATING & VENTILATING

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

Volume 32 AUGUST, 1935 Number 8

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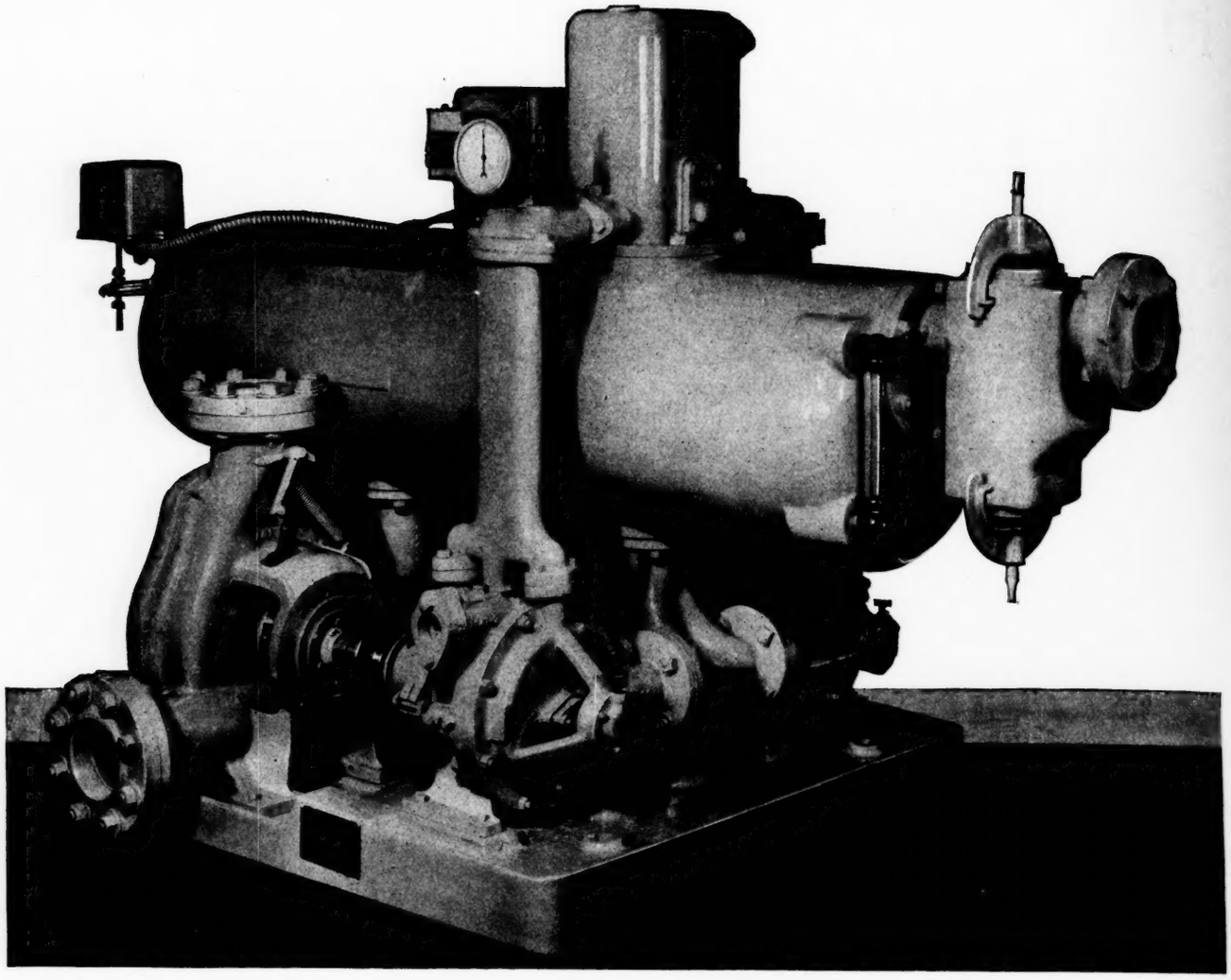

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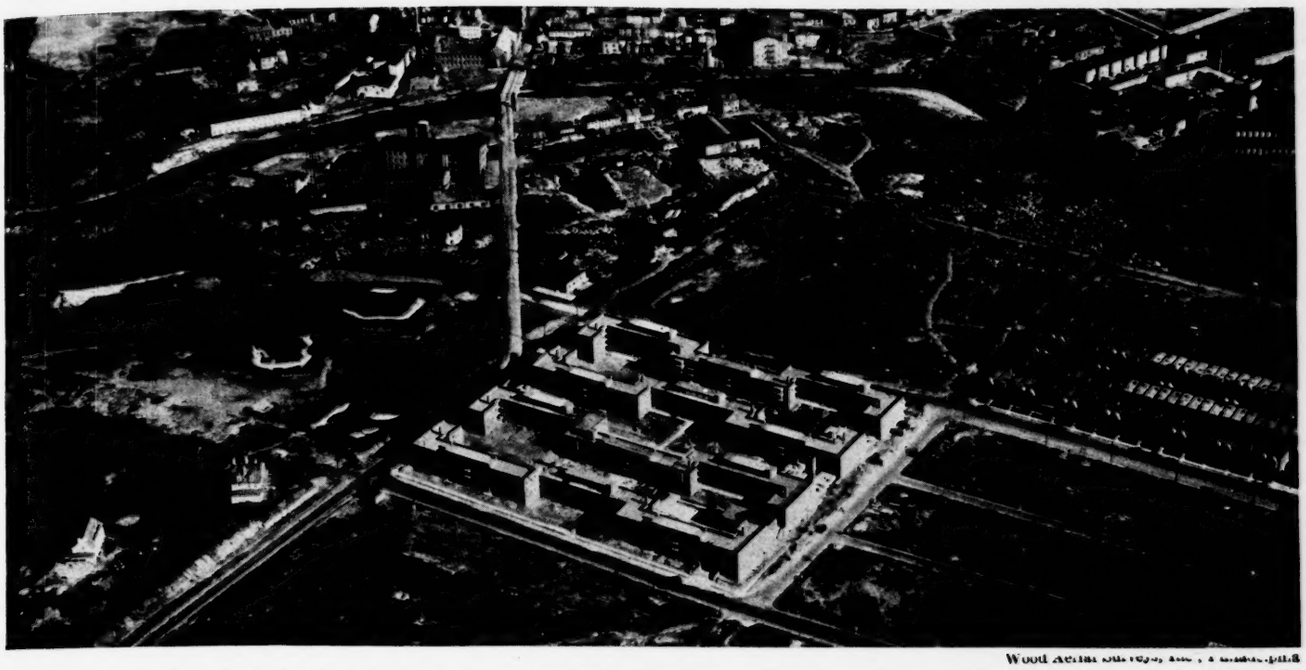


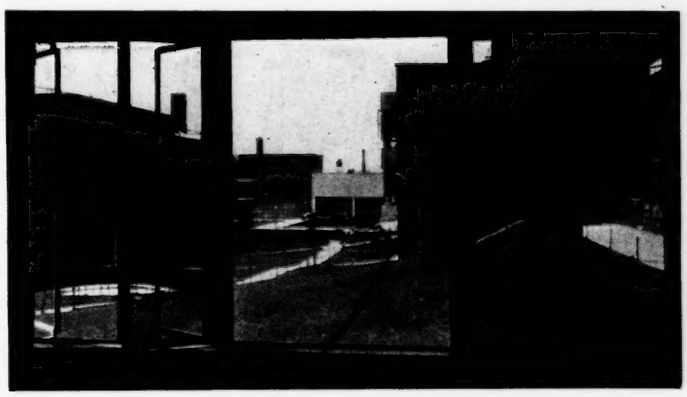
Nearness to hosiery factories is a feature of the location of the Juniata Park housing development, which was built mainly for this class of worker

Heating a Large Low-Cost Housing Project

OUR conception of housing has been gradually changing since the beginning of the depression. Activities of the government in supplying low-cost housing for both white collar workers and wage earners under various divisions of public works programs, as well as continued demand for better housing on the part of labor organizations, social workers, and others, are largely responsible for the change.

While the heating engineer is not necessarily particularly concerned with the social aspects of such housing projects he is concerned with the ultimate design, inasmuch as there are indications that such designs may have considerable bearing on his work. Cost, for instance, in this type of project, must be kept at a minimum, and the pressure on the designing engineer to do this is even greater than it ever was for commercial projects — and the pressure for low cost in boom days was great enough, engineers will fervently agree.

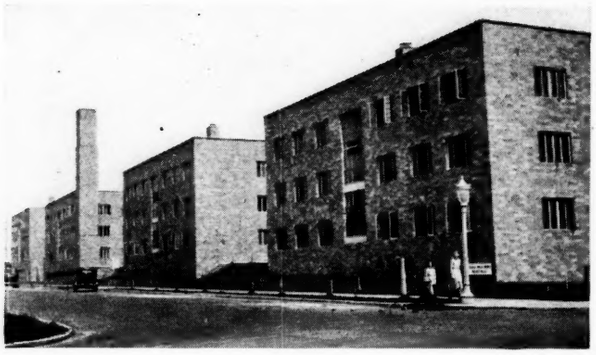
An example of how a large scale apartment project can affect the design of the heating plant to an important extent is found in the $1,153,607 (exclusive of land) Juniata Park Housing Corporation development in Philadelphia. This project was built with a PWA allotment of slightly over a million dollars primarily for the benefit of hosiery workers in Philadelphia, and is situated near a number of large hosiery mills.



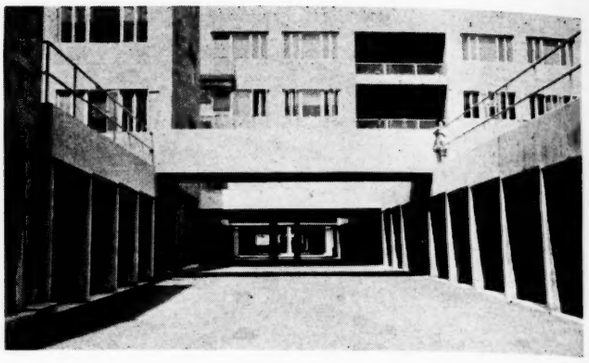
Swimming pool and courtyard as seen through the unusually large windows of an apartment

The story of how the engineer and architects overcame certain unusual problems arising from the rather extraordinary layout of the buildings, and not only met them but turned them into advantages from the standpoint of mechanical equipment, is an interesting one. Before, however, describing the heating plant it is necessary to give some attention to the background of the building in order to understand why the problems existed.

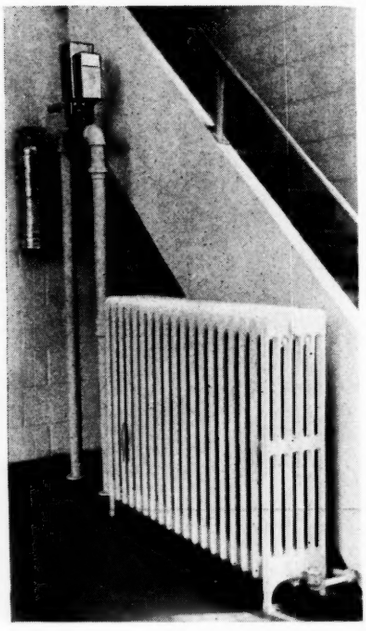
Although the third largest city in the country, Philadelphia is still essentially a single-family-home city. Philadelphia is notable for its row houses; that is, single-family houses with only front and rear walls exposed and built in rows a block ("square" in eastern Pennsylvania) long. The designers of the building had a number of objectives to attain among which were low cost, centralized utilities, and sunny cheerful rooms.



Bristol Street side of the apartments showing the stack of the heating plant. The walls of the apartments are made of light colored clay tile.

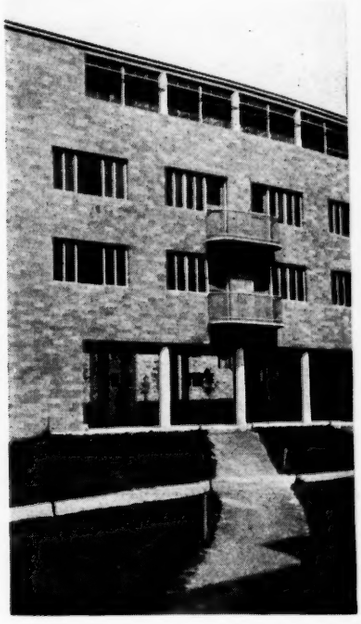


Below-grade driveway which is lined on both sides by garages. The garages are heated by the steam mains which run through them.



One of the radiators in the auditorium. Steam control valve can be seen in the rear. The auditorium is used for amateur theatricals and community gatherings.

Two of the three large cast iron boilers which are used for heating the apartments. Boilers each have 25 sections and have oil burners which use bunker C oil.



One of the passageways through the apartments which leads between the two courts. On the upper floor can be seen the windows of the laundry.

One of the very wide windows in an apartment. A low cast iron radiator can be seen just below the window. A kindergarten is on the roof of the opposite building.

Courtyard containing the swimming pool, as seen from an apartment sunporch. The building at the rear of the swimming pool is the auditorium.

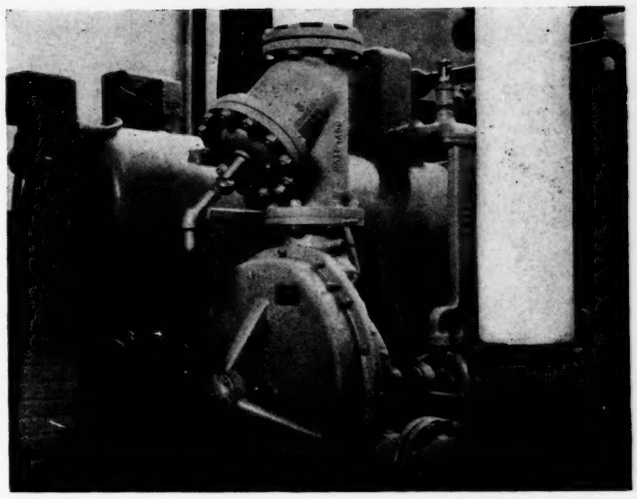
In order to successfully meet these last requirements the project was built in four separate buildings with wide lawns or courts between. The buildings are only one apartment wide so that there is cross ventilation in every apartment, and there are no inside apartments.

Centralization of families and utilities into apartments as compared with single-family houses presents some advantages but also some accompanying problems. For example, for families who do their own laundry convenient facilities for doing this work must be provided. Among the advantages are that heating can be provided at lower cost than is possible from separate isolated plants; electric power can be furnished at wholesale rates, and recreational interests of the community can better be served. These allowances were made in the Juniata project by providing a large open air swimming pool, a wading pool for children, an auditorium where amateur theatricals and community gatherings may be held, and kindergartens on the roof of each building.

In previous low-cost housing projects no recognition has been made of the fact that even low income wage earners own automobiles. It is well recognized that this is especially so in the smaller community where an automobile has become a necessity for the worker to reach his place of employment, particularly where he is at some distance from bus lines or adjacent to discontinued street car lines.

Consequently, while the inclusion of garages might not have been necessary in New York, it was felt that this need was important in this outlying district of Philadelphia. Garages are available for which tenants pay a small rental—$5 per month. These garages are built below grade and open on to a driveway which extends crosswise of the four buildings. Cars enter at one end of the drive at grade, go down an incline, through the drive, and leave from the other end of the drive (see the accompanying building layout).

In the building, which is completely fireproof (with walls of 4-in. hollow clay tile with vertical air cells on the exterior, similar 4-in. cinder concrete blocks, ¾-in. gunnite and plaster), there are 289 apartments with 1085 rooms. The first building was opened about the first



Steam condensate pump which is connected across pressure reducing valve.

of this year while the last to be completed was opened in March. The buildings are four-story with rentals ranging from $52 for the most expensive five-room apartment (and other five-room units for $42), down to $25 for a 2½-room apartment. Rentals thus average about $10 per room. The rent includes electric light, electricity for refrigeration and cooking, hot water steam heat, and use of electrically driven washing machines and irons located on the roof in such a way that the users are in the open air but shaded in the summer and entirely enclosed in the winter.

Since only a relatively small boiler room is available due to the desire to utilize all of the possible space for other purposes, the buildings are heated with cast iron boilers, there being no room for removal of boiler tubes. There are three 25-section, 60-in. cast iron boilers with a rated capacity of 26,400 sq. ft. of steam radiator each, a total rated capacity of 79,200 sq. ft. The load on these boilers is approximately 50,000 plus a very large water heating load. The boilers are fired by automatic oil burners which burn bunker C oil. These are of the high and low flame type controlled from the steam pressure. If the steam pressure builds up in spite of no demand for heat the burner cuts out.

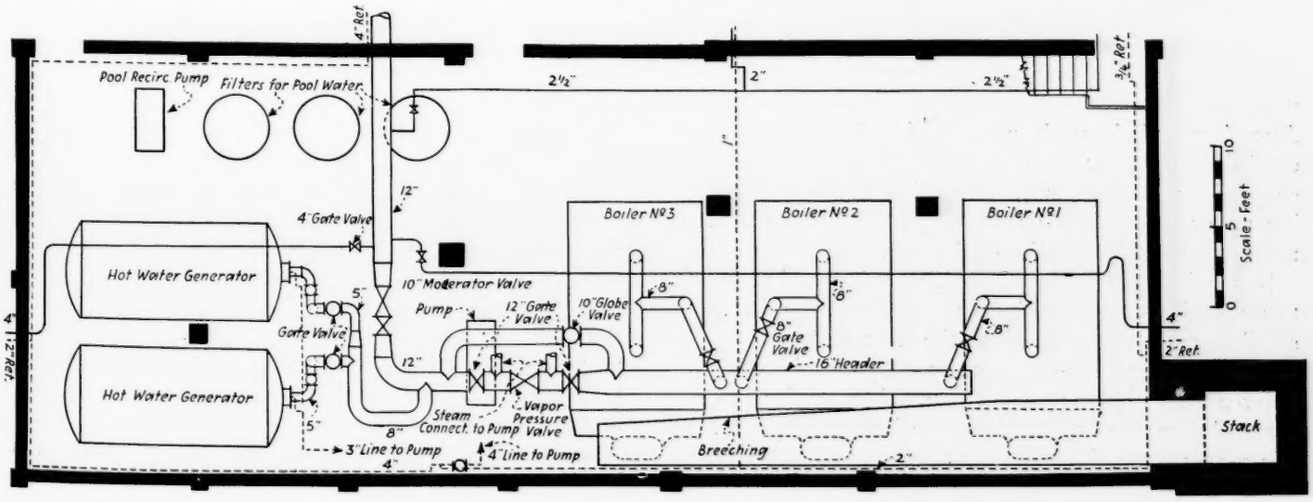


Fig. 1. Equipment layout in boiler room. Chlorinators for the swimming pool water are in corner of room.

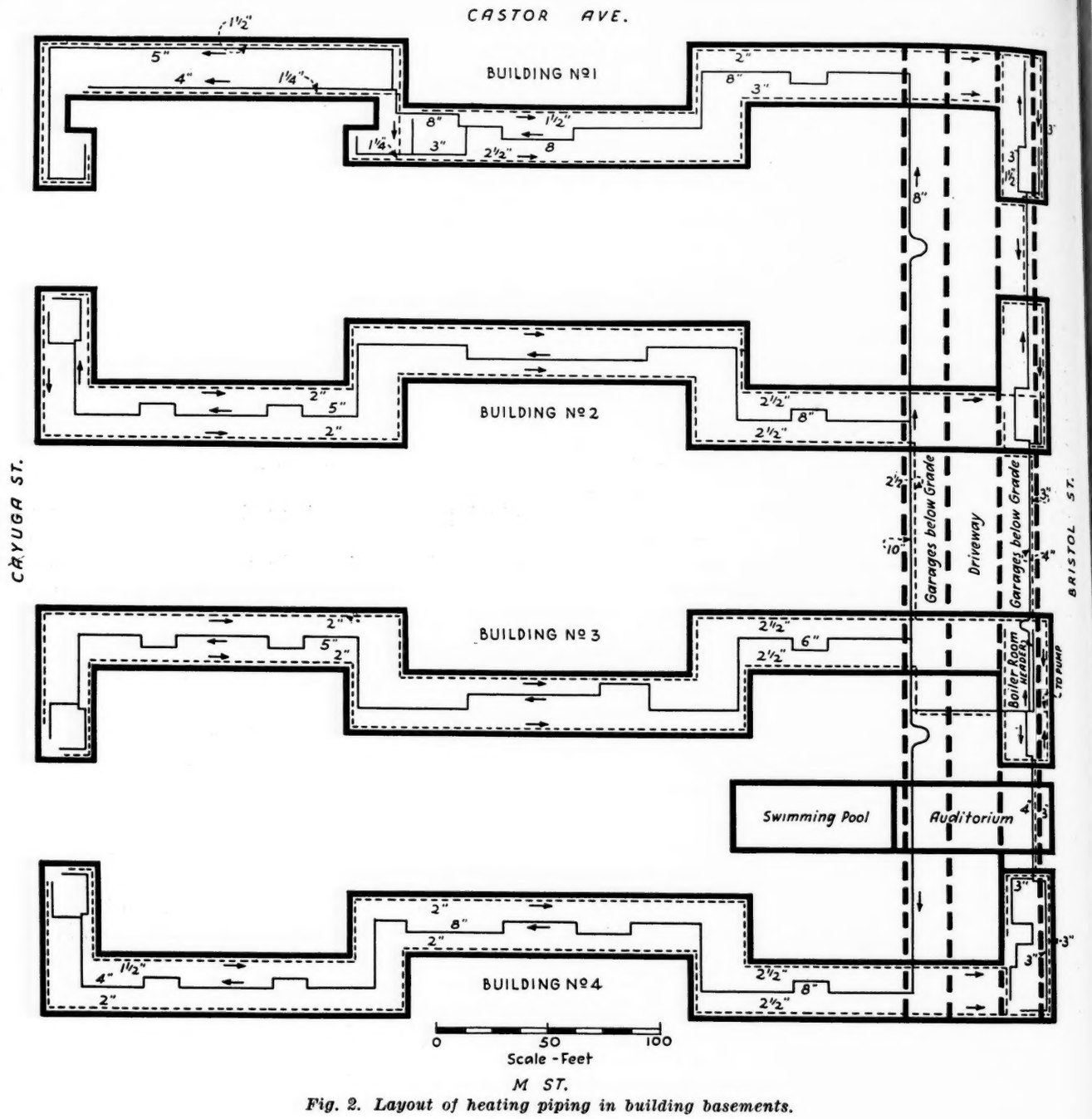


Fig. 2. Layout of heating piping in building basements.

The heating is a vacuum system controlled by a 16-position adjustable orifice in the main steam header. A moderator is located on the roof and as the weather conditions change the size of the orifice is varied, thus supplying more or less steam to the system and building up or reducing the pressure in the header with a resulting control over the oil burner.

Steam is generated at 2½-lb. pressure and reduced to atmospheric pressure by a vapor pressure valve. A small steam turbine, cut into the inlet and outlet side of the vapor pressure valves, operates on this 2½-lb. differential and drives the pump. A stand-by pump, motor-driven, is available in case of emergency. Electric power is purchased.

Fig. 1 shows the general arrangement of the boiler room which also contains the chlorinators for the swimming pool water. This drawing shows the breeching which is connected to a 54-in. square brick stack. In the connection from each boiler to the breeching is a visible smoke indicator for checking up on combustion.

Fig. 2 shows the arrangement of the principal heating piping from the boiler room to the buildings. (Detailed piping and connections are not shown.) Two outstanding points are worth noting in connection with the piping. First, the piping mains are used to heat the garages. Some heating was necessary for these buildings to keep cars from freezing and this was met by running the mains crosswise through the garages and covering them with an inexpensive form of insulation so that the heat loss through the insulation would be sufficient to keep the garages warm. The second

(Concluded on page 75)

Effect of Spray Temperature on Air

By A. H. ZERBAN†

THE influence of the temperature of the water supplied to an air washer has been strikingly illustrated by the results of a test on an air conditioning apparatus by a group of senior students in the mechanical engineering curriculum under the guidance of the author. The apparatus, diagrammatically shown in Fig. 1, consisted of a motor-operated whirling spray washer to the outlet of which was attached a plenum chamber through which the humidified air was blown. The quantity of air flowing was measured with an impact tube at the throat of a smooth nozzle placed at the chamber outlet. The temperature of the water fed to the washer was controlled by mixing into it required amounts of steam, and during a test run, the temperature was held constant.

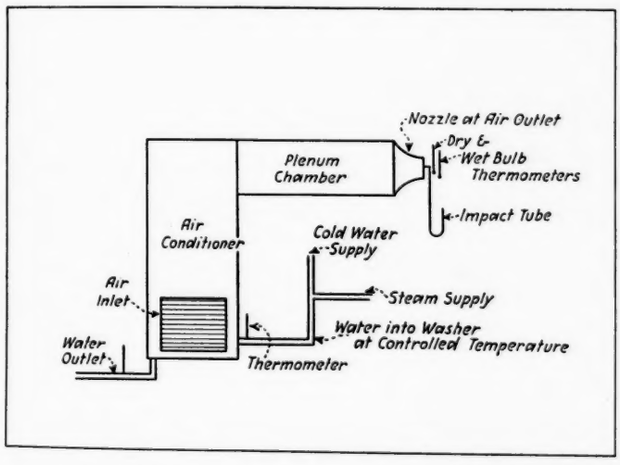
Five runs were made, water temperatures of 46°, 61.3°, 92°, 105°, and 130.3° being used. As can be seen from the curve, Fig. 2, the gain in absolute humidity, expressed in grains per pound of dry air, was 16.7 grains when the washer water was supplied at 46°, and a gain of 52.3 grains when the water was supplied at 130.3°. The intermediate values can be seen in detail by reference to the table.

The Carrier equation was used in the computations, since the barometric pressure was below the standard barometer upon which the usual psychrometric chart is based.

†Department of Mechanical Engineering, The Pennsylvania State College.

DATA FROM TESTS ON EFFECT OF SPRAY WATER TEMPERATURE ON HUMIDITY OF AIR

Run Number	1	2	3	4	5
Entering air temp., dry bulb, deg.	74.0	74.7	75.3	75.5	75.0
Entering air temp., wet bulb, deg.	55.0	55.5	57.0	58.3	58.0
Absolute humidity, gr. per cu. ft.	2.534	2.597	2.940	3.304	3.290
Absolute humidity, gr. per lb. of dry air	35.4	36.4	41.4	46.6	46.3
Exit air temp., dry bulb, deg.	62.0	64.3	69.5	70.5	72.0
Exit air temp., wet bulb, deg.	54.3	58.3	64.6	66.8	68.0
Absolute humidity, gr. per cu. ft.	3.787	4.697	6.111	6.790	7.000
Absolute humidity, gr. per lb. of dry air	52.1	65.0	86.0	95.7	99.5
Temp. of water supplied, deg.	46.0	61.3	92.0	105.0	130.3
Increase in absolute humidity, gr. per lb. dry air	16.7	28.6	44.6	49.1	53.2
Discharge, c.f.m.	1740	1745	1750	1750	1760
Barometer, in. Hg.	29.00	29.00	29.00	29.00	29.00



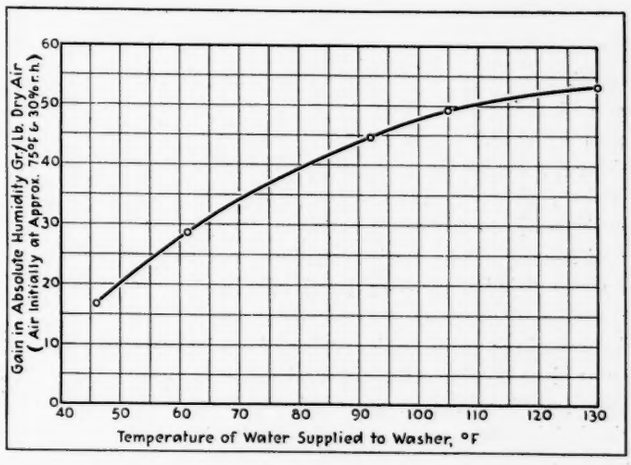


Fig. 1. (Left) Apparatus used in determining the effect of spray water temperature on air humidity. Fig. 2. (Right) Effect of water temperature on the humidity of air passing through a spray washer. This curve applies only to air entering the washer at the temperature and relative humidity indicated.

French Building Development Employs Central Hot Water Plant

WHAT is claimed to be one of the best building developments in the world is the group of apartments, recreational and municipal buildings erected recently in a suburb of Lyons, France. The residential section of the development includes 1500 apartments which range from two to seven rooms and rent for from $3.90 to $6.50 per room per month.

These moderate charges are made possible by generating all heat in a central plant. Though considerations of economy dictated its inclusion in the scheme, there were other important ends to be gained. One was the elimination of the worst of the heavy smoke from nearby manufacturing plants. These were persuaded to give up their own boiler plants and get their heat from the municipal center.

Forced circulating hot water is maintained at the high temperature of 356° to render it efficient for industrial use. This water is heated in tubular boilers much like steam boilers and carried at 44 lb. pressure to the various buildings and plants.—*The Architectural Forum.*

Residence in which cooling equipment was installed.

Tests Show Comparison of Ice and Mechanical Systems in Residence

By G. B. HELMRICH†

Tests on cooling a house by a mechanical system are compared with tests conducted in the same building when cooled with ice. Electrical cooling for one summer cost $19 as compared with an average of $40 per summer with ice

TWO years ago The Detroit Edison Company sponsored the installation of cooling equipment in a residence located in a Detroit suburb. This residence is of moderate size and has four rooms each on the first and second floors, and a maid's room on the third floor — a total of nine rooms with a volume of 19,200 cu. ft. All openings are weatherstripped and the walls are insulated with Cabots Quilt and the ceiling with Balsam Wool. All windows exposed to the sun's rays were shaded by either awnings or blinds during the cooling periods. The winter heat loss of this house at a 70° differential is 93,000 B.t.u. per hr. During the summers of 1932 and 1933 cooling was accomplished by the use of ice, but in June, 1934, the ice equipment was replaced by a refrigerating machine and direct expansion cooling coil, and this equipment was operated during last summer. The entire house, including the maid's room on the third floor, was supplied with cool air by the cooling system.

The summer's experience with this installation gives rise to certain observations which are deemed of sufficient significance to emphasize:

1. In Detroit it is quite feasible to cool a moderate-sized residence very satisfactorily with a two-ton refrigerating machine if the house is well insulated and awnings or blinds are used at the windows. Certainly a three-ton machine should be large enough even for a house which is only fairly well insulated.

2. Except under unusual circumstances, it is not necessary, nor even desirable, to supply outdoor air to a residential cooling system as natural infiltration will usually provide all the ventilation which may be required. Sleeping rooms can be satisfactorily cooled without introducing outdoor air.

3. Since the compressor capacity was somewhat less than would have been required to maintain what may be termed ideal conditions, there was no tendency toward overcooling, and the room thermostat could very well have been eliminated and the installation cost correspondingly reduced.

4. There was no objectionable lamp flicker caused by the running of the compressor, although the number of fluctuations per second (compression intake cycle) was 9.7, which is rather low.

5. A total operating cost of $19 for a cooling season can certainly be considered very moderate, and should be no obstacle to the growth of this class of comfort cooling.

Equipment and Controls

The cooling equipment consists of a two-ton refrigerating unit supplying Freon to a direct expansion, forced convection cooling coil. The coil is placed in the main return air chamber of a conventional forced warm air heating system and no changes were made

†The Detroit Edison Company.

TABLE 1. SUMMER COOLING IN A DETROIT RESIDENCE
Summary of Operating Data for 1934 Season and Comparison with Previous Summers

Cooling Medium	1932 Ice	1933 Ice	1934 2-Ton Refrigerating Machine
No. of hours of artificial cooling..	135	134	168
No. of hours of fan use only:			
Outdoor air cooling	57	120	6
Recirculation	—	—	114
Total no. of hr. of fan use...	192	254	288
Total no. of degree hr. above 85° during summer	529	1408	1345
No. of days of artificial cooling...	22	22	18*
Average no. of cooling hr. per day	6.1	6.1	9.3
Electric Energy Used:			
Ice water pump and fan—Kw-hr.	94	142	—
Compressor and fan—Kw-hr. ..	—	—	476†
Condensing Water for Compressor:			
Gal. of water per min. of operation, aver.	—	—	2.07
Total water consumption for season, gal.	—	—	20,920
Cost of Cooling for Season:			
Ice	$45.60	$30.60	—
Electricity at 2¼c per kw-hr...	2.12	3.20	$10.71
Condensing water at 20c/1M. gal.	—	—	4.18
Total operating cost	$47.72	$33.80	$14.89*
Average cost per day of artificial cooling	$2.16	$1.54	$0.83
Average cost per hr. of artificial cooling	$0.35	$0.25	$0.09

*There were five cooling days in June when machine was not available; corrected cost for the entire season of 23 cooling days = $19.05.
†135 kw-hr. for fan and 341 for compressor. Power required by compressor, 2.04 kw.

to the existing ductwork except relatively minor ones to accommodate the coil. The general arrangement is shown in Fig. 1, while some of the design data are summarized in the following:

Condensing Unit—

Refrigerant—Freon.

2 cylinder compressor—400 r.p.m.

2-hp. motor—220 volt—single phase repulsion induction.

Direct Expansion Cooling Coil—

Size of Coil Bank—29 in. x 25 in. x 9¼ in. deep—4.41 sq. ft. face area.

Face velocity of air through coils when handling 1570 c.f.m.—356 f.p.m.

Actual static pressure drop through coils 0.11 in. water.

Actual static pressure drop through entire duct system—0.265 in. water.

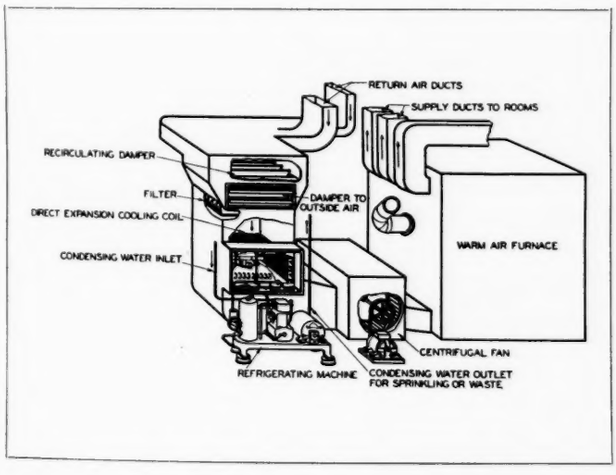
Operating coil pressure—40 to 45 lb. per sq. in.

Operating coil temperature—43° to 48°.

The operation of the machine is controlled by a thermostat located in the dining room. The control diagram is shown in Fig. 2, and the controls function in the following manner:

When the thermostat, designated F, calls for cooling, it energizes the solenoid operating the valve on the liquid line to the cooling coil and opens this valve, allowing refrigerant to flow into the coils. When the vapor pressure in the coil has built up to about forty pounds, the low pressure switch H closes and energizes the holding coil E in the compressor motor starter and closes the starting contactors in the 220-volt circuit supplying the motor and starts the motor. When the room temperature has been reduced to that of the thermostat setting, the solenoid operator on the liquid valve is de-energized by the opening of the thermostat circuit, and valve D is closed. The refrigerating machine continues to operate and "pumps down" until the suction pressure is reduced to about seven pounds, at which pressure the low pressure control switch opens, de-energizes the holding coil E, opens the starting switch and stops the motor.

As it was considered desirable to have the circulating fan start automatically with the starting of the compressor so that the occupants of the home would have only one operation to perform when desiring to start the cooling system (namely, to move the room thermostat to a setting below the existing room temperature), the 110-volt fan motor circuit was tied into two auxiliary contactors which were available in the starting box for the compressor motor. The closing of the starting contactors for the compressor motor also closes contactor G in the 110-volt circuit supplying the fan motor. This action energizes the holding coil in magnetic switch A, closing the fan motor circuit and starting the fan.



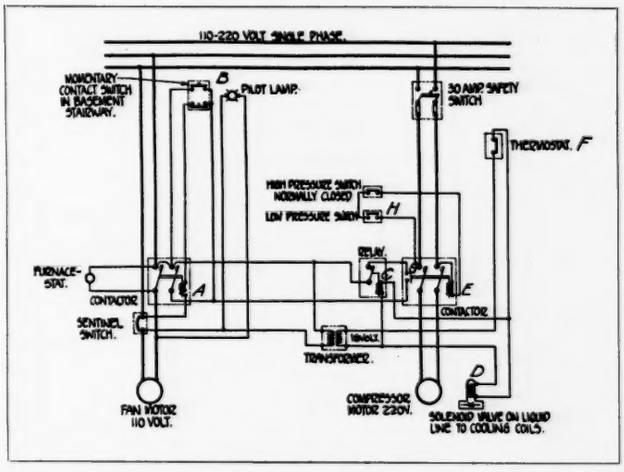


Fig. 1. (Left) Diagram of air conditioning system in Detroit residence. Fig. 2. (Right) Control diagram for cooling system showing electric compressor and cooling coils.

TABLE 2. TESTS OF COOLING SYSTEM—AIR TEMPERATURES AND RELATIVE HUMIDITY
(July 13, 1934)

Time	Outdoor			Indoor			Register		Cooling Coil	
	Wet. B.	Dry B.	Rel. H.	Liv. Rm.	Din. Rm.	Rel. H.	Kitchen	Din. Rm.	Entering Air	Leaving Air
3.15 p.m.* ..	—	87°	—	78°	80°	62.5%	66.5°	67°	74°	65°
4.00 p.m. ...	74.5°	90°	48%	—	—	—	—	—	74°	64.5°
5.15 p.m. ...	—	—	—	—	77°	53%	65.5°	66.5°	74°	64°

Cooling started at 2:45 p.m.

CONDENSING WATER:
Temperature of water entering condenser—62°
Temperature of water leaving condenser—83°
Quantity of water flowing through condenser 2.17 g.p.m.
Heat rejected to cooling water—22,800 B.t.u. per hr.

COOLING LOAD:
Sensible Heat—Air flow = 1570 c.f.m.
1570 × 60 × 0.075 × 0.2375 (74 — 64) = 16,900 B.t.u. per hr.

Latent Heat—Moisture condensed from air—2-hr. average—3.87 lb. per hr.
Indoor relative humidity at start of cooling—63%
Indoor relative humidity 2½ hr. later—53%
Latent heat load—3.87 × 1056 = 4100 B.t.u. per hr.

Total Cooling Load—16,900 sensible + 4100 latent = 21,000 B.t.u. per hr.

It is also desirable to have the circulating fan operate for an indefinite period after the refrigerating machine shuts down so that there will be no tendency for the air to stratify in the rooms, full advantage may be taken of the cooling effect produced by drawing the cool air from the lower levels and discharging it at higher elevations, and advantage of the cooling effect of air movement may be obtained.

There is an additional advantage in that the residual cooling power in the coils can be utilized by the continued circulation of air after the refrigerating machine has stopped. Although the refrigerating machine was usually shut down at about 8 or 9 o'clock in the evening, the fan was permitted to operate until the occupants were ready to retire, and then it was stopped by simply pushing the button in the momentary contact switch B located in the basement stairway.

When switch A is once energized by action of switch E and closes the fan circuit, it cannot be de-energized by the stopping of the compressor, but can only be opened by pushing the button on momentary contact switch B, so that the fan continues to operate after the compressor stops. This manual control switch for the fan was also used to start the fan independently of the compressor if recirculation of air without artificial cooling was desired, or if it was desired to cool by bringing in outdoor air at night.

Mechanical Cooling Compared with Ice Cooling

The mechanical cooling system was placed in service June 12, 1934, and operated for 18 days for a total of 168 hr. during the season. Had the system been available June 1, there would probably have been need for cooling on five additional days, according to temperature records. This would make a total of 23 days of artificial cooling for the entire summer.

In the previous two summers, when cooling was with ice, the householder experienced considerable difficulty in determining just how much ice to order. There were occasions when ice was ordered around noon time, in the expectation of a hot afternoon, but changes in the weather made cooling either unnecessary, or not required for as long a period as the ice supply would provide. As very little of the unused ice could be conserved for next day's use, this experience made the householder so conscious of the possibility of waste that he did not use the cooling system as freely as he would naturally wish to use it.

In contrast, the mechanical cooling system was started by the automatic operation of the thermostat, or by the mere pushing of an electric switch, and this ease of operation was, in large measure, responsible for the greater number of hours of use of the mechanical system as compared to that for the ice system. The very act of ordering ice seems to make the householder more conscious of the cost of cooling than he is when cooling is accomplished electrically, and the cost becomes part of his general bill for electrical service.

The other factor making for a more liberal use of cooling was the low operating cost as compared with that for ice. This comparison is brought out in the summary of operating data shown elsewhere in this article. With mechanical cooling, the number of cooling hours per day of use were 50% higher than in the previous two summers, while the operating cost per hour of cooling was about one-third to one-fourth the cost of ice cooling.

The problem of scheduling ice deliveries and the relatively high operating costs are thus both factors

TABLE 3. TESTS OF COOLING SYSTEM—AIR TEMPERATURES AND RELATIVE HUMIDITY
(July 24-25, 1934)

Time	Outdoor		Indoor			Upstairs	Cooling Coil	
	Dry B.	Rel. H.	Liv. Rm.	Din. Rm.	Rel. H.	S. Bed Rm.	Entering Air	Leaving Air
July 24—3.50 p.m.* ...	100°	26%	78.5°	—	59%	—	—	—
July 24—6.00 p.m.	100°	—	79°	81°	—	80°	75.5°	65.5°
July 25—10.00 p.m.	—	—	77.5°	—	52%	—	—	—

Cooling started at 3:50 p.m. July 24 and continued until 10:00 p.m. on July 25—30-hr. run.

COOLING LOAD:
Latent Heat—Moisture condensed from air = 5.06 lb. per hour. 5.06 × 1056 = 5350 B.t.u. per hr.
Sensible Heat—1570 × 60 × .075 × 0.2375 (75.5 — 65.5) = 16,800 B.t.u. per hr.

Total Cooling Load—16,800 sensible + 5350 latent = 22,150 B.t.u. per hr.
Note: No windows on either floor of the residence were opened during the 30-hr. cooling period and no outdoor air was drawn in, the air being completely recirculated.

which militate against the growth of ice comfort cooling for residences. The first cost of the two systems for the smaller sizes is so nearly alike that investment charges do not appreciably affect this comparison.

Tests of Cooling System

The performance of the cooling system was measured both by recording instruments and by special tests and the results of two of these tests are given in Tables 2 and 3.

Test Results

These tests results, together with observations made by the occupants, indicate that the cooling system had sufficient capacity to hold the downstairs temperature to an average value of 78° and an effective temperature of 71° to 72°. On the hottest day last summer, July 24, when the outdoor temperature exceeded 100° for a period of 3 hr., the first floor temperature did not exceed 79° in the living room. As previous tests had shown that without cooling the indoor temperature would have risen to about 85° under corresponding outdoor conditions, the cooling system can be credited with an average reduction of indoor temperature of 7°. In addition to this reduction in temperature, the relative humidity was appreciably reduced. Indoor relative humidities at the start of cooling of the order of 67 to 71% were reduced to 60 to 63% at the end of two to three hours of cooling and the relative humidity at the end of the cooling periods was from 50 to 55%. The amount of moisture condensed from the air by the cooling coils varied between 4 and 6 lb. per hr. on the days that tests were made.

The performance of the cooling system throughout the summer was quite satisfactory to the occupants of the residence. The most severe test of the system was on the occasion when the compressor was operated continuously for a period of 30 hr., the outdoor temperature exceeding 100° on the first day and 97° on the second. Cooling was started at 4 p.m. on the first day and continued until 10 p.m. on the following day. No windows were opened during this cooling period, and on the second cooling day the upstairs temperature varied between a minimum of 73° at 6 a.m. and a maximum of 79° at 8 p.m., while the downstairs temperature did not exceed 78°. Although no outdoor air was drawn into the system, the occupants reported that the condition of the air in the sleeping rooms was very satisfactory. The reduction of the indoor relative humidity to a minimum of 52% at the end of the cooling period was undoubtedly a large factor in producing such a satisfactory condition.

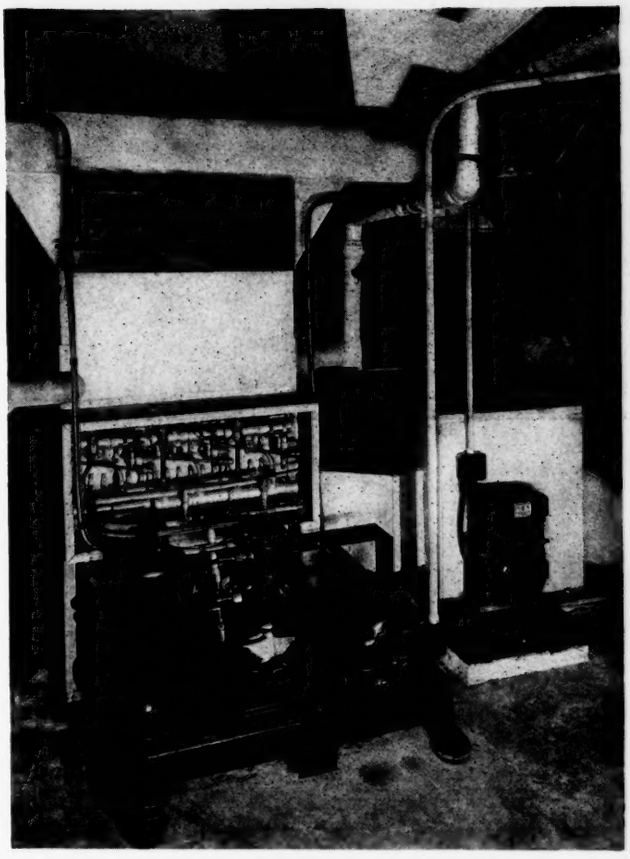


Fig. 3. Mechanical cooling equipment in Detroit residence.

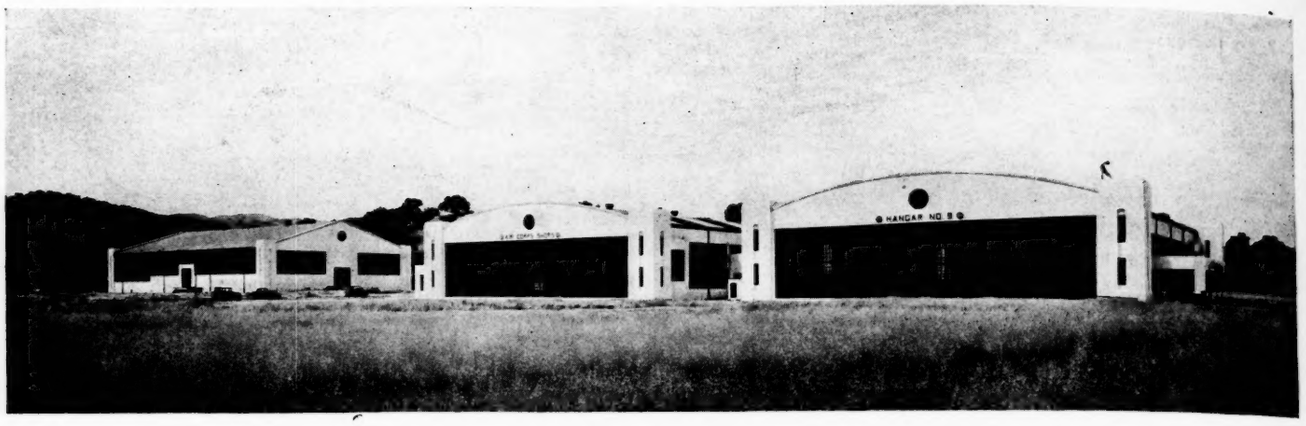
The operating noise of the refrigerating machine was in no way objectionable to the occupants, although it was audible in the living room. The compressor is supported at the four corners by laminated cork and rubber pads which in turn rest directly on the basement floor. This simple machine mounting, together with a specially balanced flywheel, made the installation quite satisfactory from the standpoint of noise.

A Direct Fired Gas Heating Installation

The Fisher Body plant, located in Kansas City, recently installed a new gas heating system for the body assembly plant. Direct fired heaters are now used in the new system; the gas is burned, the products of combustion mixed directly with air, and the mixture blown directly into the plant. Most of the air to be heated is drawn from the outside; very little of the inside air being recirculated. This method of heating is adaptable in body assembly plants due to the fact that a large amount of inside air is discharged to the atmosphere at spray booths. It would not be adaptable if a large percentage of the inside air were heated and recirculated because of the increasing percentage of carbon dioxide that would accumulate.

To clean the air it is drawn by a large fan through 4 in. of shredded glass filter. In addition the fan pulls the products of combustion from the burner and the mixture is forced directly into the plant.

The operators state that the system is very satisfactory.—*American Gas Journal.*



Group of hangars for the bombing planes at Hamilton Field.

Military Airport Heated with Gas

BEHIND the protective barrier of the Marin hills in California lies Hamilton Field, Army Air Corps' new $5 million bombing base and key point of the Pacific air defense. Declared by experts to be ideally located because shells cannot reach it in a ship-shore battle, the field is the final word in air base construction. It lies almost midway between Canada and Mexico, in a position to provide maximum mobility in new defense plans. Hamilton Field is to the Pacific what Langley Field is to the East and Fort Crockett Field is to the South. Its avowed purpose is to provide adequate protection in the event of attack on San Francisco and vicinity.

This base is virtually a self-contained community, planned to provide for operation, maintenance, and repair of a large fleet of aircraft and to house a thousand officers, men, and their families. When the additional buildings, now planned, have been erected, it will be possible for the entire personnel to live on the post, having at their disposal every essential of life, including all of the recreational facilities afforded the resident of the city.

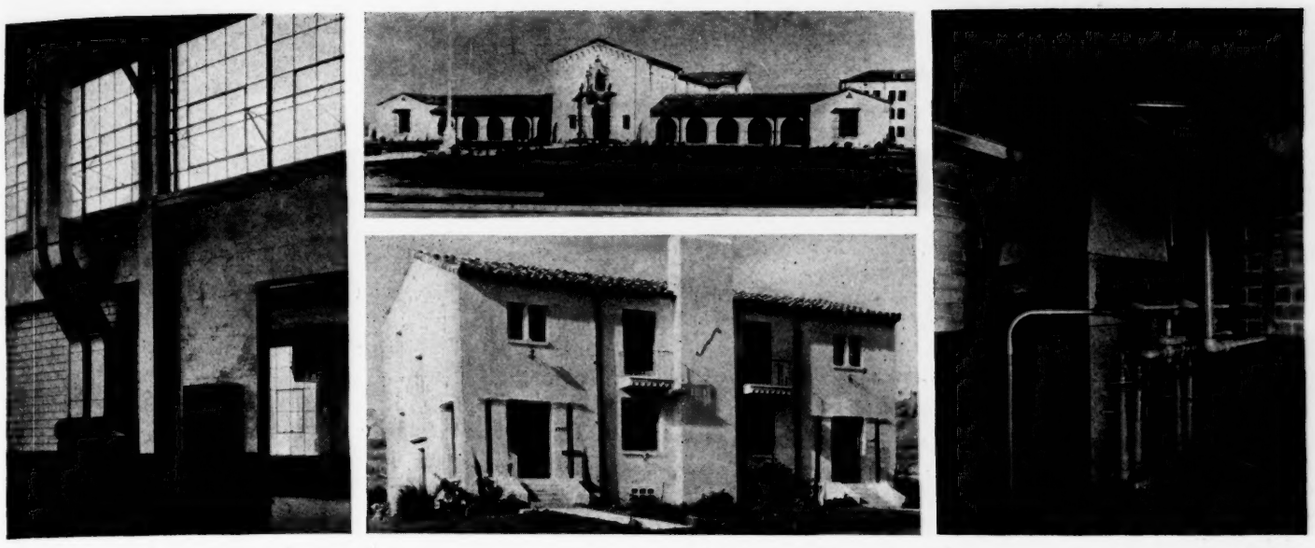
The technical area is a perfectly level tract lying at the foot of the hills which form the residential area. This space is occupied by the flying field shops, hangars, warehouses, barracks, and miscellaneous buildings such as Headquarters, Fire Station, Guard House, and garage. There are eight hangars, two double and four single. The hangars are departures from the usual type found at other bases. Larger, higher, and constructed of concrete, they are equipped to accommodate planes larger than the huge bombers which now form the principal fighting machines of the air corps.

The Army Air Corps' new bombing base from 11,000 ft. in the air.

The quarters of the officers and non-commissioned officers are built in the hills surrounding the airport. Their design was governed by three principal factors: harmony of architectural design, foundation, and earthquake possibilities. The mild climate of Marin County and its early Spanish history made natural the selection of Spanish-Colonial as an architectural motif.

The heating system of the post is rather an unusual one. When the buildings were designed it was decided to use gas for heating because of the mild climate, availability of natural gas, and ease of control. A wide variety of apparatus is used for heating the different buildings.

The heating of the large hangar buildings presented



(Left) A gas-fired blast heater with ceiling discharge for heating hangars. Gas unit heater can be seen in adjoining room. (Upper Center) Headquarters building heated by a forced circulation hot water system. (Lower Center) A non-commissioned officers' double residence heated by a gas hot water boiler. (Right) Double blast heaters which maintain 110° in one of the hangar rooms.

some especially difficult problems because of the large volume and infiltration when the doors were opened. It was finally decided to use a combination of gas-fired unit and blast heaters. The main sections of the hangars are heated by 10 floor-type blast heaters and a number of ceiling unit heaters. Ducts carry the warm air from the floor units to discharge grilles near the ceiling. The floor units each have an input capacity of approximately 150,000 B.t.u. per hr. while the unit heaters average about 75,000 B.t.u. per hr. Offices, shops, and storage spaces in the hangars are heated by ceiling unit heaters. There is a special room in one of the hangars where it is necessary to maintain a temperature of 110°. Two blast heaters, each with a capacity of 450,000 B.t.u. supply heat through ducts to this room.

All Units Automatically Controlled

All of the units except the two special ones for the hot room are operated by separate thermostats wired to the heaters through three position selector switches, so that entirely automatic operation or manual control of each unit is possible. The two special blast heaters discharge into the same duct and are operated by the same control. The temperatures maintained vary from 60° to 80° depending upon the section of the building.

Since most of the units were to operate in rooms where inflammable vapors are present they had to be so constructed that there would be no danger of the gas flames igniting these vapors. The burner box construction is such that the gas burners are entirely enclosed in a cast-iron burner box and the primary air necessary for combustion is taken from the fan motor blower and gated down into the burner. This eliminates the necessity of air openings in the burner box itself. The movement of the fan revolving at 1140 r.p.m. rapidly dissipates any inflammable vapors, making it impossible for these to collect in the fire zone and cause explosions.

Hot Water Heating Used

The barracks for the enlisted men are heated by a hot water system using forced circulation. Two circulating pumps are installed, one being kept in reserve. A gas-fired hot water boiler is used for heating the water. Hot water for showers is supplied by a gas-fired steam boiler heating a submerged coil in the storage tank. Automatic controls are used throughout.

The Headquarters building has the same type of system as the barracks building except that there is no provision for hot water supply for showers.

Each non-commissioned officers' building consists of a double home separately equipped with a gas-fired, hot water boiler and about 300 sq. ft. of radiator surface. A constant water temperature of 160° is maintained in the boiler and automatic controls keep the room temperature at 70°. Hot water is supplied by a separate hot water heater also gas fired.

The officers' homes are single dwellings and are equipped with the same type of equipment as the non-commissioned officers' quarters.

Smaller buildings on the post are heated with gas-fired steam radiators — some vented and some not. There are 17 radiators used in the officers' mess, seven in the photography laboratory, two in the ordnance warehouse, and one in the QM salvage warehouse. All are equipped with automatic pilots and controls.

Throughout the entire post all of the heating equipment is protected by gas regulators, automatic gas cut-off valves and aquastats which serve to prevent danger to the system and the occupants in the case of failure of either gas or water supply.

Multi-Speed Induction Motors for Fans and Blowers

By GEORGE H. HALL

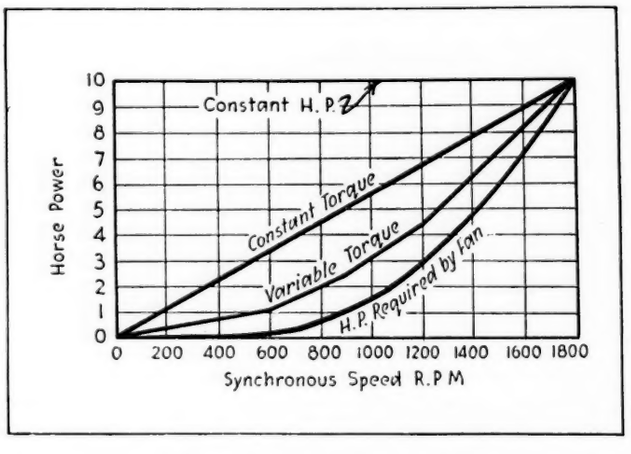
FOR the operation of motor-driven fans and blowers where direct current is available the problem of speed control is easily handled, either by insertion of resistance in the armature circuit, by which the motor speed is reduced, or by the introduction of resistance in the field circuit, whereby the speed of the motor is increased. By use of either of these methods, or sometimes by a combination of both, a wide range of motor speed can be secured to meet almost any ventilating condition.

With alternating current variable speed may also be obtained by one of several methods, each of which possesses certain advantages and some disadvantages, so that all phases of the operating conditions should be carefully considered before selecting the type of adjustable speed motor for any particular case.

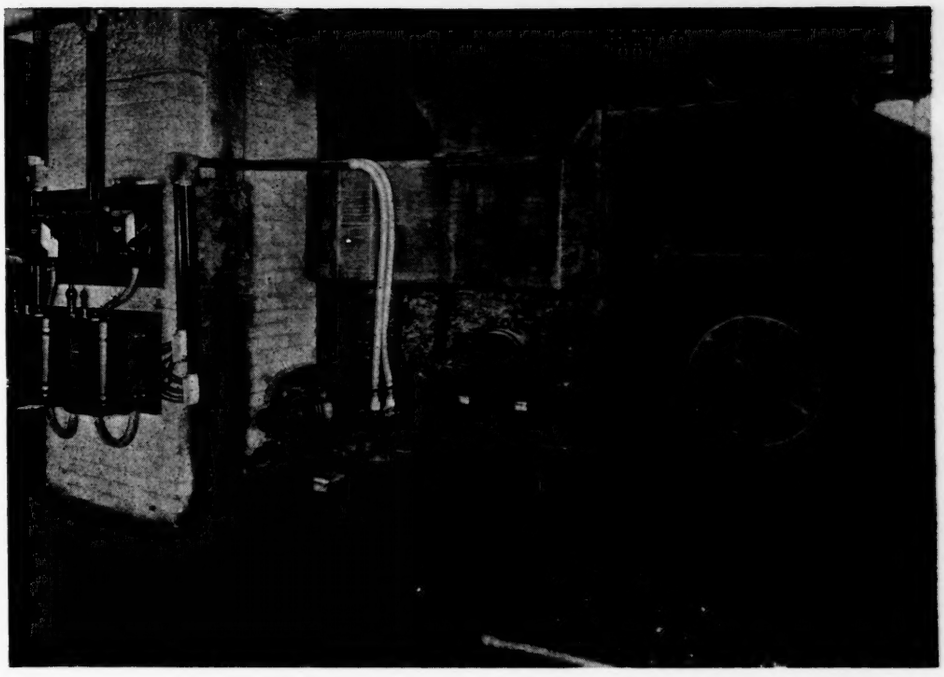
A brief consideration of the available types of adjustable speed, alternating current motors may be in order for purpose of comparison although it is the intent of the present discussion to point out the characteristics of the multi-speed, induction motor and, by comparison with the requirements of the service, to show how it is in many ways especially adapted to the operation of ventilating equipment.

Prior to the development of the multi-speed motor, the slip-ring, or wound-rotor motor was the most generally employed type of adjustable speed motor for use in this class of service. To a considerable extent the control of the slip-ring motor corresponds to the control of the direct current motor as effected by inserting resistance in the armature circuit. For adjusting the speed of the slip-ring motor resistance is introduced into the rotor, or secondary, winding of the motor and this insertion of resistance causes an increase in the motor slip which results in its running at a speed slower than that for which it is rated. As with the direct current, armature control, the decrease in speed is also dependent upon the load being carried. If a certain amount of resistance will produce a desired speed when the motor is carrying full rated load, a much greater amount of resistance must be introduced into the secondary winding to secure the same speed when the motor is carrying only partial load. When used in connection with machine drive where the torque remains fairly constant at any speed, so that the power is directly proportional to the speed, this method of speed control is generally more satisfactory than when used in connection with fans and blowers, where the power required to drive the fan decreases in proportion with the cube of the speed. This means that for fan service a large amount of resistance must be introduced into the secondary circuit to secure as much as 50% reduction of the fan speed and if greater reduction is obtained by introducing additional resistance the speed resulting will be extremely unstable, causing considerable variation from that desired as the result of but slight changes in the actual load. Commercially a 50% speed reduction is considered as the maximum practical to be secured by this method of control. Furthermore, with the large amount of resistance required to produce the necessary low speeds a great deal of current is dissipated in the resistor in the form of heat, so that the economy of secondary control is low.

The adjustable speed, brush-shifting type of motor provides a wide range of speed which is attained by movement of the brushes of the commutator of the adjusting winding. Speed control by this type of motor more nearly corresponds to that of the shunt field control of the direct current motor in that the speed is more nearly constant with varying loads, although the per cent drop in speed from no-load to full-load is somewhat greater on the low speeds than on the high. With the brush-shifting motor speed ranges as high as four to one are obtainable and, since the changes in speed are effected by the movement of the brushes over the commutator, an infinite number of intermediate speeds are available. With the slip-ring motor the number of intermediate speeds is limited to the number of resistance steps provided by the controller. As the brush-shifting motor does not require the use of external resistance for the attainment of speed reduction, its efficiency is superior to that of the slip-ring type and it is also higher than that of the armature controlled motors as used on direct current. While well suited to use for fan and blower



Horsepower curve of three types of 10-hp. multi-speed motors compared with the fan requirement.



Multi-speed motors driving circulating fans. Drum controllers and manual switches are mounted on column at left. Photo courtesy Wagner Electric Corporation.

operation, brush-shifting motors are comparatively high in price, so that their general employment for ventilating service has not become general.

The multi-speed, induction motor is in many ways the ideal equipment for ventilating service in that, while a number of speeds is available, when operating at any selected speed it possesses the characteristics of the constant speed induction motor.

In the discussion of this type of motor it will be assumed that operation is on 60-cycle frequency which is the frequency now generally standardized. For other frequencies, while the general principles are the same, the actual speed figures would be subject to modification in accordance with the variation of the frequency from 60 cycles. All speeds here referred to are the synchronous speeds, the actual full load speeds being in all cases from 3 to 5% lower.

With an established frequency the speed of a constant-speed, induction motor depends entirely upon the number of poles with which the stator is provided and may be determined by the formula

$$\text{R.p.m.} = \frac{\text{Frequency} \times 120}{\text{No. of poles}}$$

For 60-cycle operation this would read

$$\text{R p.m.} = \frac{7200}{P}$$

Thus a motor having eight poles would run at a speed of 900 r.p.m., while one having four poles would run at 1800 r.p.m.

Now if a stator having eight poles is so constructed that, by a change of the connections, either all of the eight poles or only four of them are effective we would have a multi-speed motor which would be rated at 1800/900 r.p.m. In this case the stator winding would be classed as a consequent-pole winding. Any desired number of poles might be employed in such a motor so that ratings of 1200/600, 900/450, or 720/360 r.p.m. could be obtained, the speed rating of the single wound, consequent-pole motor always being in the ratio of two to one.

If two separate stator windings were employed the motor could be built so that one winding would cause eight poles to be effective, the other twelve. This would result in a speed rating of 900/600 r.p.m. Should both of these windings also be connected for consequent pole operation we would obtain a speed rating of 1800/1200/900/600 r.p.m.

The foregoing illustrates the principle of the multi-speed motor construction and from this it will be seen how a speed range of three to one is obtained by the proper grouping of the stator poles.

The three-speed motor employs one consequent-pole winding and one single winding although in commercial practice the three-speed motor is generally built with two consequent-pole windings, but the controller is arranged to make use of but three of the available speeds.

Since with the consequent-pole winding the low speed is always one-half of the high speed, this type of motor will give speeds in pairs such as 1800/900, 1200/600, etc. For special work the speed obtainable by such combinations may not always be acceptable in which case triple windings may be used for obtaining such speed combinations as 1200/900/720/600 r.p.m.

While a wide range of speed may be obtained by the use of this type of motor, on the other hand the number of speeds is limited to a few steps. This may in some particular cases cause an objection that will render the multi-speed motor unfitted for the required service, but in the majority of fan and blower drives it will usually be found that satisfactory ventilating results can be obtained when the motor speeds available are 1800/1200/900/600 r.p.m., or for lower speeds 1200/900/600/450 r.p.m., both of which combinations constitute commercially standard ratings and both are obtainable by the use of a double, consequent-pole winding.

Multi-speed motors are built in three types, based on their respective torque characteristics, each of which is suited to the demands of the service for which it is employed. These types are: (a) constant horsepower, (b) constant torque, (c) variable torque.

With the constant horsepower type the torque developed by the motor increases in the inverse proportion to the speed of the motor so that the product of the torque and speed, and therefore the developed horsepower, remains constant throughout the entire working

range of the motor. Such motors are used largely on machine tools where slow cutting speeds are employed when removing heavy cuts so that the torque demand on the motor is greatest at the slowest speeds.

The constant torque motor develops the same torque at any speed within its range and, since horsepower is a factor of torque and speed, the horsepower output of the motor is directly proportional to the speed at which it is operating. These motors are particularly adaptable to driving such machines as require a certain torque for the performance of the particular function for which they are designed. Thus, if a package wrapping machine requires a certain torque to perform the operation of wrapping a package, this same torque will be exerted at whatever speed the machine is run but the horsepower expended will be directly in proportion to the speed at which the machine is operated. A reciprocating pump, delivering water against a fixed head, or height, would be another illustration of the proper application of the constant torque motor. The head or pressure of the water remaining constant, the horsepower expended will be in direct proportion to the speed at which the pump is run, corresponding to the actual work performed as represented by the number of gallons delivered per minute.

In the third class, the variable torque, the torque decreases directly with speed, consequently the horsepower output is reduced in proportion to the square of the speed. Theoretically the horsepower demand of fans and blowers decreases in proportion to the cube of their speeds although, as the friction load is not subject to the same rule, a decrease of one-half of the speed would actually require somewhat over one-eighth of the power to drive.

The established practice of decreasing the motor horsepower in proportion to the square of the speed, therefore, follows the general line of fan demand at the same time providing a margin for any contingent increase in the fan demand above the theoretical requirement. This characteristic of the variable torque type of multi-speed motor makes it especially suited to this class of service and as, in the majority of ventilating installations, satisfactory operation can be obtained by the use of a motor having three or four available speeds, it is being more and more generally adopted for ventilating and air conditioning work.

The accompanying curve has been drawn for a 10-hp., multi-speed motor of the three classifications and it will be seen how the curve for the variable torque type accommodates itself to the curve representing the horsepower demand of a fan which requires 10 hp. for its operation at maximum speed.

The following tables of relative horsepower outputs show the percentage of full rated load that may be derived from the three types of multi-speed motors at the various speed points through the most generally adopted speed ranges:

Speed in r.p.m.	600	900	1200	1800
Constant horsepower.	100%	100%	100%	100%
Constant torque	33.3%	50%	66.6%	100%
Variable torque	11.1%	25%	44.4%	100%

Speed in r.p.m.	450	600	900	1200
Constant horsepower.	100%	100%	100%	100%
Constant torque	37.5%	50%	75%	100%
Variable torque	14%	25%	56.2%	100%

Multi-speed motors may be operated manually or by automatic control. When manually operated, a drum-type, pole-selecting switch is used to establish connections between the line and the proper grouping of the poles in order to secure the speed desired. After speed setting by the drum, the motor is started by a manual switch or by a magnetic switch actuated by a push button. In the case of motors of a capacity too great for throwing directly across the line a compensator or resistance starter is used.

In some types of speed-setting drum switches the handle by which the selector drum is operated also acts as a momentary contact switch for actuating the magnetic starter so that semi-automatic operation is obtained.

For full automatic operation the drum selector switch is replaced by a number of magnetic contactors, one for each speed for which the motor is to be used. The starting station has a series of contact buttons, in the case of a four-speed motor indicated as "high," "medium high," "medium slow," "slow" and "stop." The selector contacts are interlocked with the magnetic line switch, or automatic compensator, so that whenever a speed button is depressed the motor is automatically started and operates at the speed corresponding with the button that has been pressed.

House-Heating with Electricity

THE contractor's camp at Grand Coulee Dam in Washington is today a laboratory for extensive experiments in heating houses electrically. Three- and four-room houses, prefabricated, are set up ready for occupancy in three days' time. Electric heaters, ranging from 1.5 to 5.0 kw., will be used to heat the various rooms. Electric water heaters and ranges are also supplied each house. Annual cost of electricity for heating, lighting, and cooking will lie between $60 and $75.

Adequate insulation in walls, floors, ceilings, and roofs of houses should permit of satisfactory heating by radiant electric units. One experiment on heat storage consists of heating a special oven full of boulders during the night hours, the stored heat heating the house during the daytime. This and other experimental studies with different types and design of insulation are being directed by engineers from the State College of Washington.—*Agricultural Engineering.*

Design, Installation, and Operation of an Institutional Heating Plant

5—Mild Climatic Conditions Require Complex Temperature Control System

By CARL J. ECKHARDT, Jr.†

IN order that its buildings may be properly and economically heated, The University of Texas, located in Austin, operates two central heating plants. Twenty-five of its buildings are heated from the main heating and power plant and eight additional buildings are heated from the institution's Little Campus heating plant. An inspection of the accompanying tables reveals the fact that climatic conditions in this region are indeed mild.

Weather records for an extended period of time reveal that the heating season is normally of 160 days' duration, that is, the normal daily temperature reaches 65° on its downward trend on October 26 and it again reaches 65° on its upward trend on April 3. During this period the lowest temperatures are reached the first week in January. The normal temperature on the coldest day of the year, January 6, is 48.8°.

An inspection of the meteorological data presented in tabulated data reveals the following information relative to atmospheric conditions which affect the heating activities at The University of Texas.

1. The temperature reaches levels lower than 32° on

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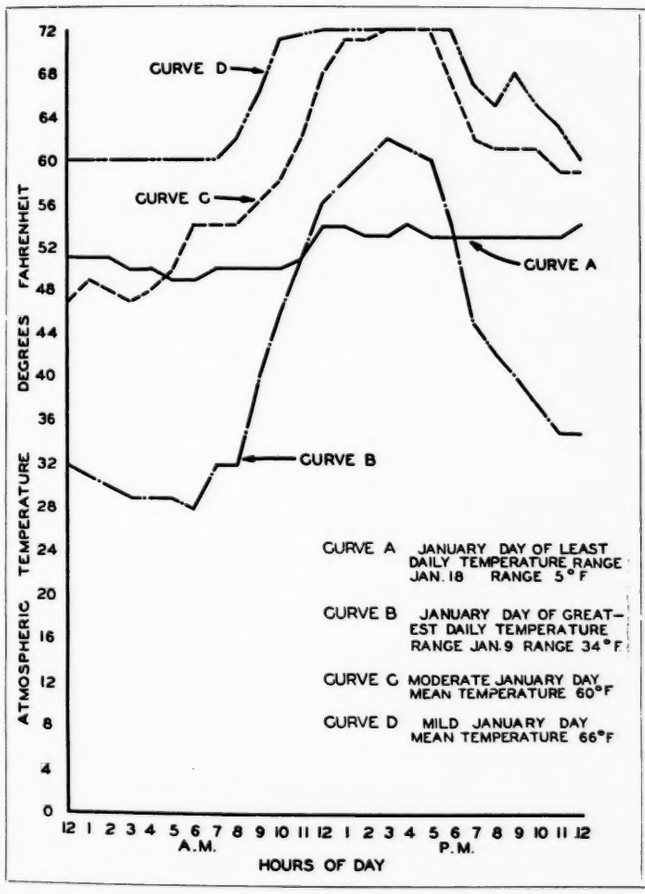


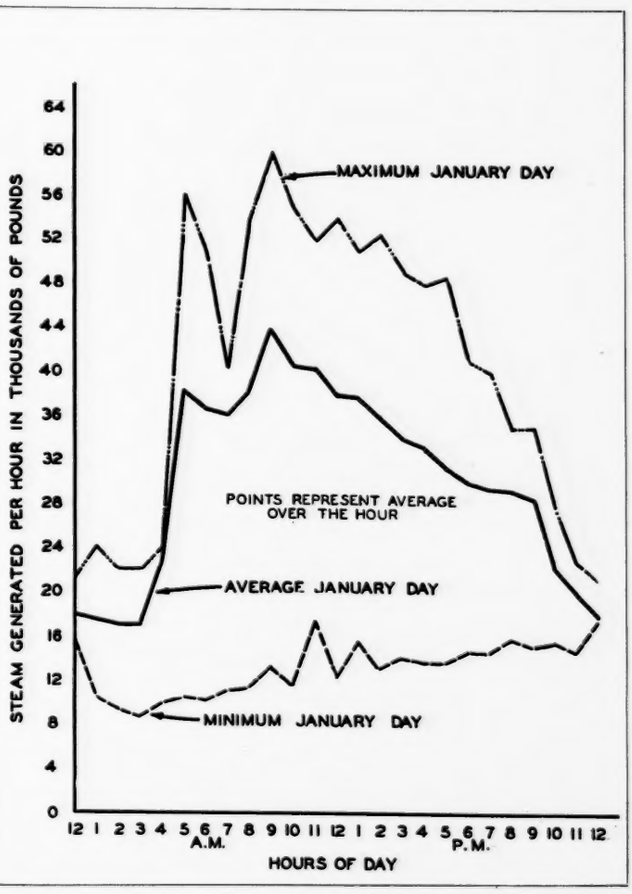


Fig. 1. (Left) Hourly weather variations for four types of days in January. Fig. 2. (Right) Heat load characteristics for three types of days in January.

only a few occasions during a heating season.

2. Daily temperature ranges are comparatively great throughout the heating season.

3. On clear days the temperature rise from 7 a.m. to 12 noon is generally very rapid.

4. A cold spell is usually accompanied by a brisk northwest wind, which rarely lasts more than a few days. During the period intervening between these northers, comparatively warm weather is usually experienced.

5. Lowest temperature of the day is usually experienced at 7 a.m.

6. Percentage of possible sunshine actually experienced is comparatively high.

7. Average hourly wind velocity approximates 8.5 miles of movement per hour.

8. Daily relative humidity range averages about 30%.

These data make it obvious that in Austin serious heating problems cannot be attributed to the severity or longevity of the heating season, but arise due to moderate weather and to variety of climatic conditions.

Operation of Heating Equipment

The institution's central heating plant is so operated that steam at a pressure of 200 lb. per sq. in. is available at each building at all times. On the average winter's day buildings are heated the same number of hours that the buildings are occupied. For instance, in the case of each specific building, steam at a pressure from 1 to 5 lb. is admitted to the system within that building about two hours before its occupants arrive and the heating operations may be discontinued two hours before the building is vacated. The two-hour period is not required to heat the building to the desired temperature. A much shorter period can be used, but the frequency with which the systems are operated and made inoperative makes highly desirable a very gradual admission of steam to reduce the maintenance on the piping systems. On a number of winter days heating operations may be discontinued by 12 noon. On some days even in midwinter no heat is required at all. These circumstances make the services of an alert and careful operating organization essential.

The daily heating schedule depends upon the temperatures experienced. An inspection of Fig. 1 reveals a wide variety of conditions which must be considered by the heating operations organization. Heating operations are on some occasions begun in the afternoon rather than in the early morning hours.

The widely varying temperatures experienced necessitate the operation of central heating plants under highly variable loads. The curves in Fig. 2 show January heating load characteristics. The severity of the conditions imposed on steam generating equipment can be observed by comparing the load on moderate days with that of severe days.

Control Equipment a Necessity

Due to the great variety of weather conditions experienced the need for temperature control equipment was early recognized by the engineers of The University of Texas. In original installations comparatively simple systems were installed. An observation of the results accomplished with the passage of time clearly demonstrated that automatic heat control, despite a popular impression that it was a luxury, was in reality a serious necessity. The principal reasons for applying control systems were to:

1. Maintain conditions required for human comfort and efficiency.
2. Obtain economy in operation.
3. Provide necessary safety measures.

The economies effected by early systems of heat control soon justified the use of more complicated systems in later buildings.

Because of the desirability of maintaining temperatures within close limits the control systems for all heating equipment, with the exception of members operating the fans of unit heaters, have involved the use of indirect-acting thermostats. The medium which has been selected to operate valves and adjust dampers is compressed air. A separate motor-driven air compressor with suitable storage tank is located in each building in which temperature control equipment is used. All buildings constructed by the university in the past ten years have been provided with such equipment. The size and nature of each air compressor has been determined by the amount of equipment to be controlled.

Each air compressor is provided with a suitable cut-off switch by means of which it automatically becomes inoperative when no compressed air is needed.

In view of the fact that direct heating systems have most frequently been installed in buildings constructed, the predominant type of system of temperature control employed has been a system by means of which the steam admitted to each radiator or convector would be controlled. The control system selected needed, therefore, to actuate the valves provided to control steam flow into the heat emitting members.

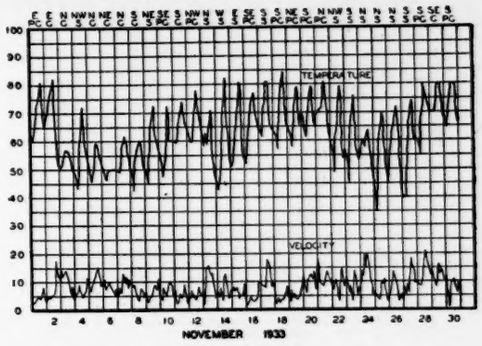
Use of sylphon bellows rather than rubber diaphragms for operating valves in connection with automatic temperature regulation has been regarded as essential. A variation of the pressure of the air in the bellows causes the admission valve to be suitably opened and closed.

Indirect Acting Thermostats Used

In direct heating systems positive type of indirect acting room thermostats has been generally used. The actuating device consists of a straight bimetallic strip. As the temperature to which the thermostat is exposed tends to rise above the upper limit for which it is adjusted, the bimetallic element covers a leak port in the compressed air system to which it is connected. The closing of the leak port builds up the pressure in the sylphon bellows of the radiator valve so that this valve is properly closed. As the air to which the thermostat is subjected subsequently cools to the lower limit for which the thermostat is set, the bimetallic element uncovers the leak port and thereby relieves the pressure in the sylphon bellows of the control valve causing it to

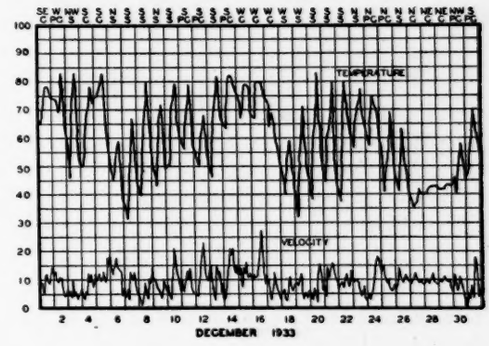
Mean Monthly Temperature	62.4 Deg.F.
Normal Temperature This Month	58.5 Deg.F.
Highest Temperature This Month	84 Deg.F.
Lowest Temperature This Month	35 Deg.F.
Total Precipitation	0.68 In.
Mean Relative Humidity 7 A.M.	80 Per Cent
Mean Relative Humidity 12.31 P.M.	50 Per Cent
Mean Relative Humidity 7 P.M.	56 Per Cent
Prevailing Wind Direction	South
Total Wind Movement	5753 Miles
Average Hourly Velocity	8 M.P.H.
Maximum Velocity for 5 Minutes	27 M.P.H.
Clear Days	12
Partly Cloudy Days	10
Cloudy Days	8
Total Hours of Sunshine	183.4
Per Centage of Possible Sunshine	57 %
Highest Relative Humidity	100 %
Lowest Relative Humidity	26 %

November, 1933



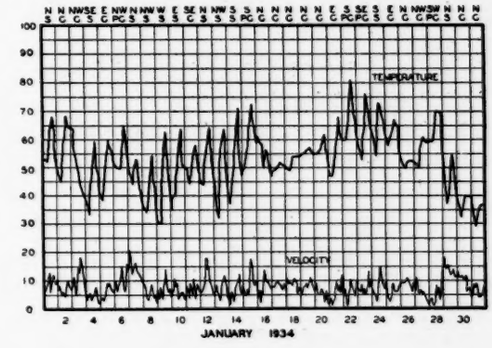
Mean Monthly Temperature	59.6 Deg.F.
Normal Temperature This Month	51.0 Deg.F.
Highest Temperature This Month	83 Deg.F.
Lowest Temperature This Month	31 Deg.F.
Total Precipitation	1.24 In.
Mean Relative Humidity 7:00 A.M.	78 Per Cent
Mean Relative Humidity 12:31 P.M.	50 Per Cent
Mean Relative Humidity 7:00 P.M.	49 Per Cent
Prevailing Wind Direction	South
Total Wind Movement	6679 Miles
Average Hourly Wind Velocity	9.0 M.P.H.
Maximum Wind Velocity for 5 Minutes	27 M.P.H.
Clear Days	13
Partly Cloudy Days	9
Cloudy Days	9
Total Hours of Sunshine	179.4 Hours
Per Centage of Possible Sunshine	57 %
Highest Relative Humidity	97 %
Lowest Relative Humidity	8 %

December, 1933



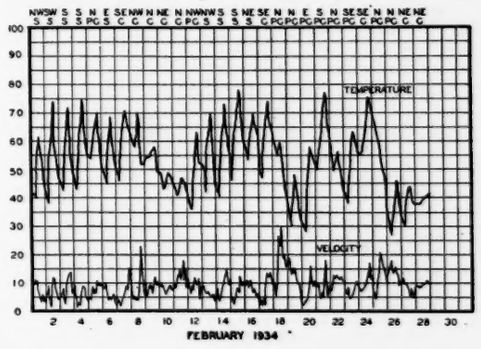
Mean Monthly Temperature	53.0 Deg.F.
Normal Temperature This Month	49.5 Deg.F.
Highest Temperature This Month	81 Deg.F.
Lowest Temperature This Month	29 Deg.F.
Total Precipitation	9.13 In.
Mean Relative Humidity 7 A.M.	85 Per Cent
Mean Relative Humidity 12:31 P.M.	67 Per Cent
Mean Relative Humidity 7 P.M.	68 Per Cent
Prevailing Wind Direction	North
Total Wind Movement	5719 Miles
Average Hourly Wind Velocity	7.7 M.P.H.
Maximum Wind Velocity for 5 Minutes	25 M.P.H.
Clear Days	11
Partly Cloudy Days	5
Cloudy Days	15
Total Hours of Sunshine	150.9 Hours
Per Centage of Possible Sunshine	47 %
Highest Relative Humidity	100 %
Lowest Relative Humidity	21 %

January, 1934



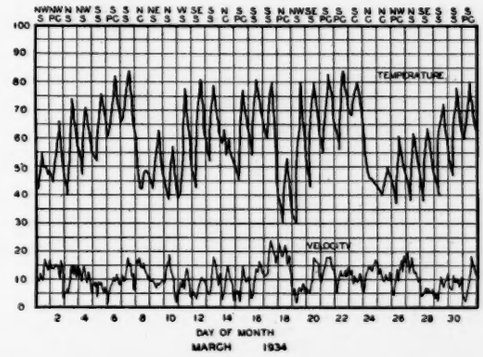
Mean Monthly Temperature	53.3 Deg.F.
Normal Temperature This Month	53.4 Deg.F.
Highest Temperature This Month	82 Deg.F.
Lowest Temperature This Month	27 Deg.F.
Total Precipitation	2.15 In.
Mean Relative Humidity 7 A.M.	82 Per Cent
Mean Relative Humidity 12:31 P.M.	54 Per Cent
Mean Relative Humidity 7 P.M.	56 Per Cent
Prevailing Wind Direction	North
Total Wind Movement	5930 Miles
Average Hourly Wind Velocity	8.8 M.P.H.
Maximum Wind Velocity for 5 Minutes	32 M.P.H.
Clear Days	9
Partly Cloudy Days	10
Cloudy Days	9
Total Hours of Sunshine	117.2 Hours
Per Centage of Possible Sunshine	57 %
Highest Relative Humidity	99 %
Lowest Relative Humidity	26 %

February, 1934



Mean Monthly Temperature	58.9 Deg.F.
Normal Temperature This Month	60.7 Deg.F.
Highest Temperature This Month	84 Deg.F.
Lowest Temperature This Month	30 Deg.F.
Total Precipitation	3.82 In.
Mean Relative Humidity 7 A.M.	83 Per Cent
Mean Relative Humidity 12:31 P.M.	51 Per Cent
Mean Relative Humidity 7 P.M.	47 Per Cent
Prevailing Wind Direction	South
Total Wind Movement	7629 Miles
Average Hourly Wind Velocity	10.3 M.P.H.
Maximum Wind Velocity for 5 Minutes	30 M.P.H.
Clear Days	17
Partly Cloudy Days	8
Cloudy Days	6
Total Hours of Sunshine	258.2 Hours
Per Centage of Possible Sunshine	69 %
Highest Relative Humidity	98 %
Lowest Relative Humidity	16 %

March, 1934



open and thereby admit steam to the radiator or convector.

The necessity for a more complicated control system came as a natural effect of physical plant development. As the amount of steam required for heating and ventilating purposes grew greater the amount of money which could be expended to save steam naturally grew greater. It became desirable, therefore, to control each room at each of two predetermined temperatures—a day temperature and a night temperature. A temperature of 70° was regarded as desirable in classroom buildings and offices from 8 a.m. until 5 p.m. A few occupants in such building, however, remain in their offices until 10 p.m. With the original heat control systems all rooms would be maintained at their normal temperatures during the five additional hours that a few individuals occupied their offices. The need for a system which would permit these few rooms to be maintained at their normal temperatures, but which would use no heat to maintain regular day temperatures in unoccupied rooms became at once apparent. For that reason a dual system of heat control was provided for later buildings.

A feature of this dual control system is a thermostat which makes possible two accurately controlled temperature levels. The day temperature range of this instrument is 60°-80° and the night temperature range is 40°-60°. The thermostat controls accurately within 1° of the temperature for which it is adjusted. By this arrangement day temperatures of 70° are maintained during a period of nine hours daily from 8 a.m. until 5 p.m. After 5 p.m. no additional heat is provided to the heat emitting members until the room temperature has decreased to 40°. As the temperature in any room drops to 40° an amount of steam just sufficient to maintain a 40° temperature is admitted. If, however, the occupant of an office wishes to work in his office after the predetermined period during which normal day temperatures are maintained, he may simply press a button on the thermostat in his office and restore the day temperature level in his office independent of the lower temperature level in all other offices. This eliminates the necessity for heating all rooms in order that a few rooms may be occupied, and the saving effected is great.

Transition from a day temperature to a night temperature and vice versa is accomplished by a change in pressure of the compressed air system. This change is automatically made by the use of a suitable clock mechanism.

Control of Recirculated Air

In indirect heating systems the relation between fresh and recirculated air used has been controlled by dampers. In the larger systems dampers are connected in multiple in such a fashion as to provide a suitable opening for any amount of air desired. In some of the indirect heating systems, described in a previous article of this series, the temperature of each room is controlled by the proportions in which heated and tempered air are mixed. Mixing dampers actuated by damper motors are required to regulate the proportions of the two kinds of air used. The arrangement of the dampers is such that if the room served by that damper reaches its lower temperature limit an intermediate acting thermostat changes the position of the mixing dampers in such a fashion as to admit more heated air and less tempered air. Compressed air at the same pressure as that used to actuate steam control valves by the use of suitable thermostats is used to actuate the damper motors.

The compressed air by means of which damper motors for dampers other than mixing dampers are operated is controlled by suitable switches which are in reality two-branch, three-way switches. Such switches are mounted on suitable control panels.

Types of Thermostats in Use

Two specific types of thermostats have been used quite generally in the indirect heating systems installed in buildings at Texas University. In the indirect heating systems a definite temperature of heated air must be maintained regardless of the arrangement used. For such purposes a duct type of thermostat has been applied.

The sensitive element is arranged for insertion into the duct and the thermostatic element is arranged to be exposed outside the duct for adjustment purposes. Such thermostats are used to maintain definite heated air temperature regardless of whether the heated air is discharged directly into the space to be heated or whether the heated air is mixed with tempered air before it is discharged into spaces to be heated.

In buildings in which various rooms are to be maintained at the same or different temperatures by the mixture of heated and tempered air, additional room thermostats are required. The operation of this intermediate type of room thermostat causes the mixing dampers, operated in conjunction with them, to assume positions so that the tempered air and heated air are mixed in the proper proportions to create the condition desired in the particular room in which the thermostat is located.

The practical usefulness of heating systems depends upon their capability adequately to warm occupied building spaces in all weather conditions. Extremely cold weather is, however, rarely experienced in Austin. The operation of heat emitting units, designed to be adequate for the severest conditions, must for the foregoing reason be such as to prevent overheating during more than 95% of the heating season. Conditions observed in buildings in which automatic temperature control systems have been installed have been found to be far superior to those in buildings in which the heat emission is subject to manual control. The maintenance of healthful temperatures at which effective and efficient work can be done has received serious consideration. Experience and data secured from the operation of automatic control equipment in the course of the past ten years have conclusively demonstrated the desirability of using this equipment. The expenditures made for this serious necessity are regarded as an excellent investment.

THE END

MODERNIZING SECTION

Air Conditioning Eligible for $50,000 Modernizing Loans

Interpretation of act includes air conditioning equipment. Housing Loans hold up in volume, prove good insurance risks. U. S. active in modernizing its buildings

WITH extension to $50,000 on commercial and industrial properties of the amount insurable under the modernization credit plan of the housing act, greatly increased interest is reported from many sources. Air conditioning equipment is receiving especial attention.

In many types of business air conditioning is now accepted as a necessity. Progress made during the past four or five years in securing acceptance for general commercial use in restaurants, theaters, department stores, specialty shops, funeral homes, beauty parlors, barber shops, and a wide variety of other business is too well known to create comment now. In most cases it has been found that air conditioning pays for itself in increased profits. Many storekeepers have reported that with air conditioning they not only have more customers, but the average sale per customer is greater.

For some time after the adoption of the $50,000-limit amendment there was considerable confusion as to just what types of equipment might be included under the general terms of authorization in the changed statute. A recent ruling has tended to clarify this situation. This ruling states that administration-insured loans may be used in modernization that covers the installation of equipment or machinery in buildings where such installations are "peculiarly adapted to the business conducted therein or necessary to the operation thereof." This places air conditioning equipment well within the boundaries prescribed and such installations are definitely on the administration's approved list.

Modernization credit for such purpose may be obtained from approved financial institutions, in amounts up to $50,000. Such obligations are payable in equal monthly installments within a period of five years.

Further impetus has been given to this type of modernization activity by the recent decision of FHA to set the interest rate on all classes of its insured loans at a maximum of 5% per annum. This ruling, already in effect, makes possible a saving of ½% over the former top rate.

Lending Rate Helpful by States

Stewart McDonald, acting federal housing administrator, in a recent statement pointed out that while more than $200,000,000 of private capital for the modernization and repair of all types of buildings, for construction of new homes, and for the financing of existing mortgages, had been released through insured loans under the operation of the National Housing Act since last fall, the preponderance of this huge sum has been made available since March 16. This has been due largely to relaxed and liberalized provisions of FHA operations and to the fact that in many states new legislation has made it possible to insure loans that formerly were not available due to legal restrictions. No less than 45 state legislatures, meeting since the first of the year, have passed enabling legislation of this character. Illinois and Pennsylvania were the last to act.

A late report shows that more than 234,000 loans for modernization purposes have been insured by the FHA since its inception, with a total dollar volume of $95,364,604. To date 113 claims for defaulted modernization credit loans have been paid by the administration, amounting in all to but $52,663, indicating that this financial plan for bringing obsolete buildings up to date is a sound one.

FHA has evinced a keen interest in cooperating with manufacturers of equipment and machinery eligible for modernization operations under the enlarged program made available by extension of the dollar limit of insured operations to $50,000. Not only have conferences been held with the representatives of such concerns in an effort to develop marketing plans for materials, but a booklet now in process, titled "Modernize for Profit," will be issued shortly. This publication will contain suggestions for capitalizing on the new potential field for equipment and machinery.

Modernizing in U. S. Buildings

The federal government is itself one of the largest building modernizers at present. Almost daily new projects involving heating, ventilating or air conditioning are being placed on the market for bids.

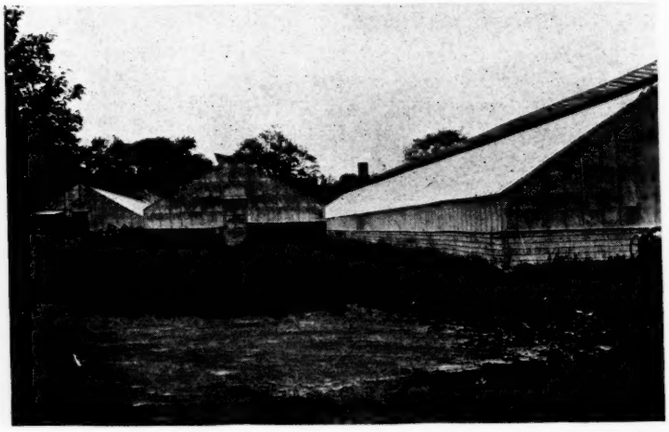
Immediately following the announcement of the forthcoming new Department of the Interior building, costing $11,000,000, which is to be completely equipped with air conditioning, comes a statement that an extension of the U. S. Archives Building at Washington will be built at an estimated cost of $3,610,000. Specifications for this project call for the installation of another large air conditioning system. Bids for this undertaking are being received for opening on August 5. This structure will be erected under the supervision of the Procurement Division of the Treasury Department. A partial list of prospective bidders on this job include the Struck Construction Co., Louisville, Ky.; Cauldwell-Wingate Co., 101 Park Ave., New York; Frainie Bros., 19 West Franklin St., Baltimore; Chas. T. Wills,

(Concluded on page 74)

Greenhouse Installs Stoker and Circulator, Saves $658

TYPICAL of the many modernization heating projects being executed in commercial greenhouses is that at the establishment of Thomas Watkins, Sea Cliff, L. I., by Walter Poetsch, Wantagh, L. I., heating contractor, where the substitution of a single, tubular boiler for two cast iron sectional plants of smaller size proved a sound investment.

There were, prior to last fall, four greenhouses in constant use. They were the following sizes—25 ft. x 100 ft., 25 ft. x 150 ft., 32 ft. x 200 ft., and a small display house 25 ft. x 25 ft. These totaled, roughly, 12,000 sq. ft. of glass. Some of these houses were 28 years old and, like most aged structures, the passing years had loosened the framing joints, heating lines had become choked with rust, and other deteriorating factors had made this establishment hard to heat. The buildings had hot water heat.



Watkins' greenhouses where a new boiler, circulator, and stoker saved $658 in one season

When hot water has to flow by gravity 250 ft. or more, as in the case at the Sea Cliff establishment, circulation at the end of the long line is likely to be sluggish. When this occurs in very old piping systems the resistance to circulation due to leaky joints, scale and rust makes gravity circulation uncertain. This is precisely what occurred at the Watkins plant. One of the first remedies suggested by the contractor was the addition of an electric water circulator. This was installed and improved conditions at once.

As in most greenhouses more than 10 years old, the customary situation as regarding boilers is to add a new boiler every time two new greenhouses have been added. Consequently, this owner had two boilers to heat the four houses. These boilers were burning 100 tons of egg anthracite annually which, at $12 per ton, represented a yearly fuel bill of $1,200. The cost seemed high to the owner so that he asked for advice from Contractor Poetsch. He suggested a 54-hp. tubular boiler to replace the two sectional boilers.

The change was made, and at the same time an electric-driven screw-feed mechanical stoker was installed by the Nassau Engineering Co., Glen Cove, L. I., in the side of the boiler, without pitting. Briefly, the modernization here included a new boiler, stoker, and circulator, together with several enlargements in supply line connections to the larger boiler header installed. This resulted in cutting the fuel requirement to 70 tons of soft coal at $7.75 per ton, a gross saving in fuel cost in a single season of $658.

The surplus capacity of the new boiler permitted the grower to add a new greenhouse during the past spring, this being 25 ft. x 160 ft., bringing the total glass area now served to 16,000 sq. ft. The return lines from the new house and from the 200-ft. long house join near the circulator, so that this handles the return from these two houses. The new boiler has two headers, one a 6-in. which is reduced to 5 in. between the boiler and the longest greenhouse, whereas a 4-in. supply line handles the new house. The other boiler header is 5 in. and serves the other three houses, with proper grading according to size of house.

Pipe coils in the houses themselves were unchanged. Coils are beneath benches and along sides of outer walls in all except the new house, which has an overhead supply line and wall coils on the return. The circulator is said to have increased circulation from four to six times over the old rate of flow and handles up to 25,000 gal. per hr. of water.

These physical changes, besides having saved the florist about $600 in the first season due to the use of cheaper fuel and fewer tons, have provided a further advantage in bumper crops, this being due to uniform temperature in houses, which in turn makes for better, stronger plants and larger and more numerous blooms. The grower attests to the fact that never in his experience has he enjoyed such good crops and such good blooms as during the past season.

Formerly one of the sons slept in the greenhouses near the boiler during severe weather to replenish fuel as the need arose. Now the employes and proprietor enjoy undisturbed rest. The grower states that he would be willing to modernize just to secure the extra sleep, which has definite commercial value when translated into daily work activity.

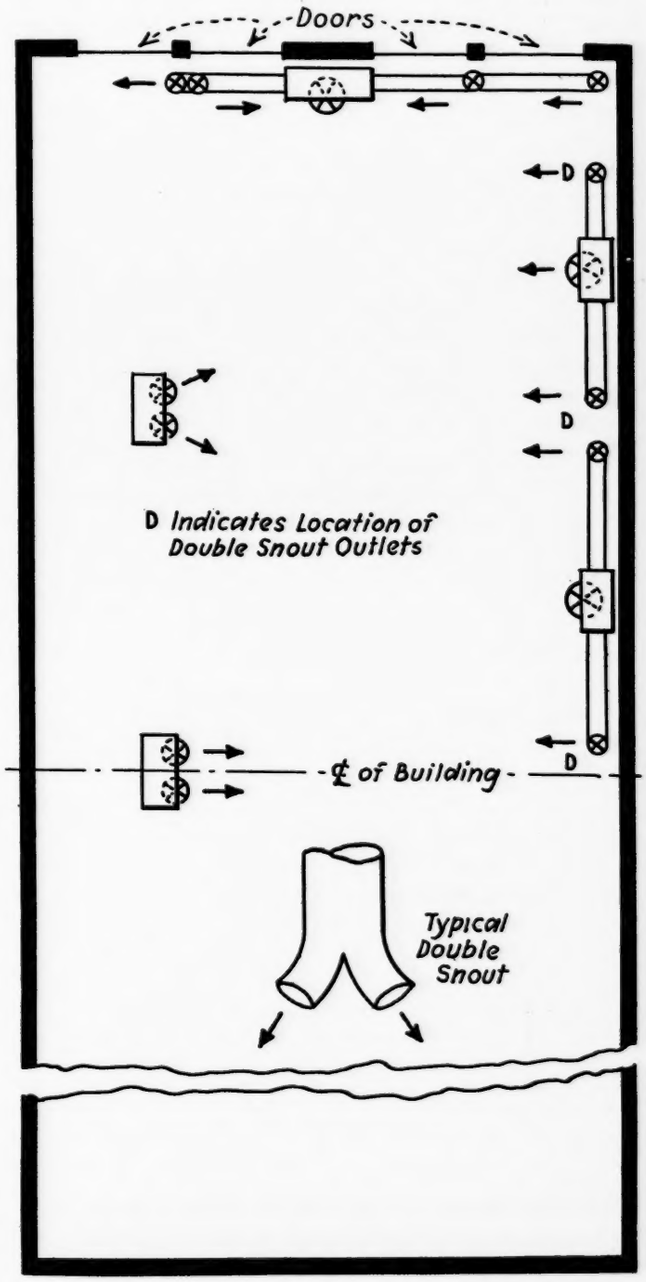
Unit Heaters Improve Bus Garage, Replace 3 Miles of Pipe Coils

AN outstanding example of unit heaters installed to replace an old pipe coil system is that in the Brooklyn Bus Corporation's combined shop and garage. This building is 900 x 100 ft. and previously was heated by 16,000 lin. ft. of pipe coil placed against the outer walls on all four sides.

Before it was decided to modernize last year the previous system had several faults. It required too much fuel; it required more than an hour to gain the desired temperature of 65°, and practically the entire time of one mechanic was required to keep joints tight and the system functioning.

When Koithan & Pryor, New York sales engineers, were asked to modernize they found pipe coils 2,000 ft. long per pipe and eight lines per header. Four large doors for use of buses take up the front end. Only the boiler room and small service doors are in the opposite end. There are no doors in the sides. Naturally any building in active use housing between 200 and 300 motor buses must have its large doors open practically the whole year. Formerly the front end of the structure was useless except for storage, the temperature being so low due to open doors that almost no repair work could be effected within 100 ft. of the entrance area.

This had the tendency to force repair work to the rear, leaving considerable space at the front useless. Hence one of the first moves of the engineers was to install a large fan-type unit heater 40 ft. above the floor against the front end of the building. From the discharge side of the enclosed heater three large ducts were extended with ends 3 ft. above the floor and near each large door. The result was a curtain of warm air flowing across each entrance.



Layout of Brooklyn bus garage showing location of unit heaters

Two additional heaters were installed against the northwest wall, one near the front and the other in the middle of the wall, or about 375 ft. from the entrances. Almost opposite these heaters two others were placed, but with the front unit midway between the opposite units and the rear unit about 475 ft. back, or slightly beyond the center of the structure.

Instead of the southeast units being placed against the wall, however, they were erected on platforms 40 ft. above the floor and equipped with vertical delivery ducts, two for each unit. These do not extend to the floor level, as do the openings of northwest ducts, but deliver 20 ft. above the floor.

From an operation standpoint the heating change permitted greater use of the front of the room than before. As the unit heaters are entirely recirculating, quick warm-up is assured, but 15-min. operation being required to render the room suitable for work activity. Ten pounds steam pressure is normally carried and the condensate is pumped back to the boiler feed water heater. The boiler is oil-fired.

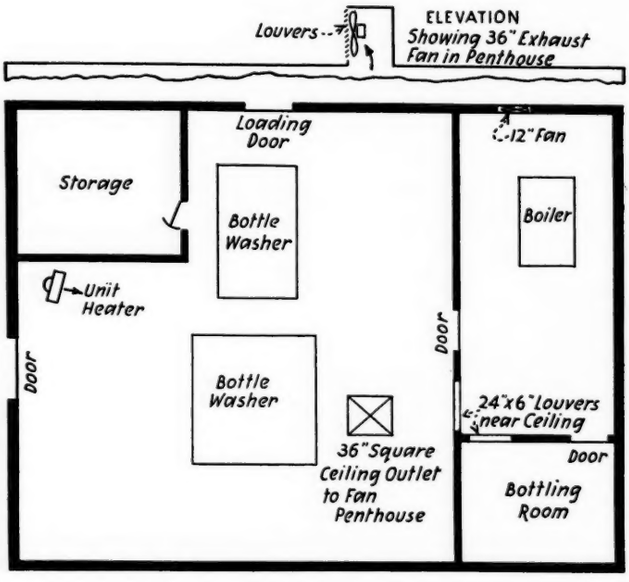
Further modernization

was conducted by the owner in this building through the addition of large motor-driven, cased, pressure-type blowers at the rear to exhaust carbon monoxide fumes. From the fan inlet several 12-in. ducts are run to convenient points with 6-in. drops terminating 3 ft. above the floor. The end of each branch riser duct, or drop, is provided with wing nuts and clamp so that exhaust manifolds of buses that have to be run can be directly connected to the exhaust line. Thus, instead of discharging CO into the atmosphere, then eliminating it with one or more large exhausters, practically no CO is discharged in the room. The blower exhausts the gases to the atmosphere through the roof without any CO having been discharged into the garage interior. Should CO escape into the room and approach the health danger point alarm bells at various points warn workers to leave the area.

Ventilation Rids Dairy of Vapor and Flies

DAIRIES represent a profitable field for the sale and installation of ventilating fans. Use of electric fans offers many advantages including riddance of flies in summer and exhaust of steam vapor in winter.

A case in point is the Norwalk (Conn.) Dairy Company building. The Lockhart Heating Company found modernization profit a few months ago by installing for the dairy two electric propeller fans, louvers, unit heater and labor to accompany the apparatus.



Layout of Norwalk Dairy

The problems were typical of dairies in other localities. Briefly they are vapor removal, heating and riddance of flies. Those familiar with milk handling recognize that before bottles can be filled they must be washed by machine with hot water. Pasteurizing releases additional steam and heat that combine to make dairies uncomfortable places in which to work, especially in winter when doors and windows are closed. Condensation drips from walls and ceilings.

Exhaust Fans Installed

Prior to the installation at Norwalk the steam vapor often became annoying. It was evident that some remedy must be taken and the management recalled the recent solicitation of the heating contractor. By placing a 12-in. exhaust fan in the wall of one room, conditions there were made comfortable. As most of the vapor was released in a larger, adjacent room it was apparent that another and larger fan must be installed there. This was done by erecting a penthouse on the roof directly above, the building being only one story.

The fan, 36-in. in diameter, is set in one side of the penthouse. To keep out bad weather and winter cold during times when the fan is not in operation a multivane louver was placed in front of the fan discharge. This proved satisfactory in removing vapor but withdrew too much heat in winter. Hence, the system was modified by installation of an overhead unit heater 30 ft. distant from the fan and blowing in the general direction of the exhaust fan.

Bottle Washing Room Ventilated

The contractor did not consider the work complete until he had also taken care of a small room on the remote side of the bottle washing room. This is the bottling room. Although there are two windows in this room they are kept closed the year around to keep out street dust. This made the room uncomfortable and ventilation was desirable.

The simplest method of handling the situation proved to be the cutting of two long openings in the walls near the ceiling through which air is drawn by the large exhaust fan. Into the wall openings, each 24 in. long and 6 in. deep, were set two flat louvers, or vanes. These do not interfere with freedom of air flow and prevent drafts.

Generally speaking, flies avoid circulating air. The 3-min. air change afforded by the exhausters, by providing rapid circulation, has aided materially in keeping flies away.

Reducing Operating Costs by Changes in Mechanical Equipment

By G. KENDRICK BRINGHURST†

This is the second of a series of articles by the author giving case histories of numerous examples of modernizing the mechanical equipment of buildings to reduce operating costs. Last month's article described savings made in a hotel and two loft buildings

IN a seven-story loft building containing 445,000 cu. ft. of heated space, with 4800 sq. ft. equivalent radiator, the cost of coal for heating the building and supplying hot water to the ground floor restaurant, and removal of ashes, was reduced from $1641 to $790. This building had a two-pipe heating system with thermostatic traps at most of the radiators and gravity return of condensate to a basement receiver and pump unit.

The two 60-hp. H.R.T. boilers were thoroughly cleaned and the brick settings made tight, a new breeching was installed, chimney brickwork was repaired eliminating cracks, pipe coil radiators which made up 23% of the total load, and which were in bad shape, were replaced by direct cast iron radiators. By the shifting of radiators on the different floors the load was balanced, radiator runouts were regraded where running traps occurred in the lines, and replaced where undersize, the basement hot water supply piping and hot water storage tank were insulated, and rice coal was substituted for buckwheat, since the 90-ft. chimney providing adequate natural draft for rice size fuel.

The boilers were cleaned, repairs made to the brick settings, and the tubes turbined under contract, but all of the other work was done by the operating engineer and one helper during the summer. The total cost, including contract work, materials, six weeks' time for one pipe fitter's helper, and engineering services, was less than $1000, returned in the savings of a little more than one year.

$158 Investment Yields 60%

In a two-story property, 50 ft. x 230 ft., the ground floor was occupied by stores on each side of an arcade connecting with front and rear streets. The building had foundations designed to carry four additional floors, and the steam heating boiler, mains and risers were installed for the ultimate six-story requirements.

With 55% of the stores and the entire second floor untenanted, the coal consumption was 90 tons of buckwheat. All radiators in the vacant stores and 70% of the second floor load were kept turned off.

The boiler was steel, double tubes, with two coal magazines and four inclined grates, having sufficient capacity to supply about four times the load required for the spaces then rented, and all four grates were in use.

As the stores had sufficient radiators installed to provide for a 65° temperature rise, even allowing for cold ceilings, all radiators on the vacant second floor could be turned off, excepting possibly one unit in each of the two wash rooms during severe weather. In addition, the janitor was instructed to use only the two middle grates of the boiler, the two outer grates remaining filled with ashes. As the chimney was 86 ft. high, rice coal was substituted for buckwheat. Firing rice on inclined grates requires a certain amount of skill to prevent loss through the buckwheat grates, but after a few weeks' experience the janitor had no further difficulty.

With the boiler load decreased 19% due to turning off second floor radiators, and burning rice coal on half the available grate area, the cost of fuel for a comparable degree-day season and the same load as formerly, was reduced from $569 to $365, a saving of $204, and the only cost involved was for engineering services.

An additional saving of $98 was realized at this property by reducing the size of the city water connection from 2 in. to 1 in. The minimum charge for a 2-in. ferrule was $130 for 130,000 cu. ft. of water, and for a 1-in. ferrule, $32 for 32,000 cu. ft. All water used in excess of the minimum quantities cost 40 cents per 1000 cu. ft. Checking back on the meter readings it was found that the highest consumption, with both floors rented, had been less than 21,000 cu. ft., and under reduced occupancy was averaging about 11,500 cu. ft. As there was no reason to believe the building would have additional floors added for some time, the smaller size ferrule would more than supply the present maximum requirements.

The cost of opening the street, changing the ferrule, permit, and piping changes inside the building, was $158, and the return on investment 60%.

Warehouse Steam Costs Reduced $1239 Annually

A six-story warehouse and loft building, with 900,400 cu. ft. of heated contents heated by street steam, used 4,001,000 lb. of steam during a 4125 degree-day season for an installed load of 11,800 sq. ft. equivalent radi-

†Consulting Engineer, Philadelphia.

ator. The steam consumption per degree-day per 1000 cu. ft. of heated space was 1.077 lb. and cost $3854, or at the rate of 96 cents per 1000 lb.

Heating was by two-pipe steam, downfeed risers, with thermostatic traps at all radiators, and gravity flow to a basement receiver from which the condensate was pumped through ceiling coils to heat the basement, thence to the sewer.

According to the owner's contract with the steam utility the monthly maximum demand charge could not be less than 90% of the highest demand charge established during the preceding seven heating season months, and as this demand charge was averaging about 60% of the total monthly charge at this property, it was extremely important to keep the maximum demand as low as possible.

The owner of the building had installed a motorized valve in the steam supply, controlled from an indoor thermostat. However, heating became so unsatisfactory that the owner decided he needed engineering advice.

Upon analysis, it was found that, although the valve installation had caused a 9% decrease in steam consumption, it had increased the maximum demand 14%, so that the valve was removed. Previous to installing this valve, a weighted lever pressure reducing valve had been manually regulated in accordance with the variation in outdoor temperatures. The operator never opened the valve wide, holding down the rate of steam flow as much as possible. As the building had slightly insufficient radiator surface it was slow in heating up. With the thermostatically-controlled valve, however, it opened to full capacity upon demand, causing maximum steam flow. The building heated more quickly, but at the same time a high demand was being recorded. In addition, unsatisfactory heating resulted from the thermostat location and the fact that the valve failed to operate at times.

Because of the high cost of street steam, it was decided to install an oil fired boiler and generate the steam required. Using no. 5 fuel oil with a full automatic horizontal rotary burner having pressure control, required no additional labor and there was a chimney and space available to accommodate this unit. The total cost of the installation, including tubular steel boiler, oil burning equipment, 2000-gal. oil storage tank, wiring and controls with an automatic water feeder and low water cutoff, necessary piping changes, and engineering fee, was $3270.

During the following 5000 degree-day season, the oil used was 60,500 gal., or about 50,000 gal. if compared to the previous season when purchased steam had cost $3854. As the cost of no. 5 oil was 4¼ cents per gal., the total operating cost, including electricity and servicing, amounted to $2225. Including interest and depreciation, the annual charge of $2615 showed a saving of $1239, and the return on investment was 38%.

Oil Burner Pays for Modernizing Home Plant

In a three-story suburban residence using purchased steam, the property was located about 1½ miles from the central plant at the end of a main which was overloaded and inadequately dripped. Heating was so unsatisfactory during severe weather that the owner decided to provide his own boiler, but in making the change he had no thought to effect savings, his object being to obtain a comfortably heated house and plenty of domestic hot water.

Six adults, including a servant, occupied the house which was heated by gravity hot water, the total load being about 1200 sq. ft. equivalent radiator. Hot water for house-heating and domestic water supply was generated in a heat exchanger in the basement, the domestic water passing through an automatic gas heater which acted as a booster. The cost of gas for raising the temperature of this water and for cooking was $93 during the eight months' heating season, $45 during the remaining four months, a total of $138 for the year. As the purchased steam cost $250 during a 4500 degree-day season, the annual charge for both gas and steam was $388.

For an outlay of $850, made on the deferred payment plan, the owner had installed a vertical steel boiler and full automatic oil burner unit, one 144-gal. oil storage tank, water circulator, coil water heater, insulated hot water storage tank, necessary wiring and controls, and piping work.

During the following 12 months, based on the same number of degree-days as for the previous year, no. 3 fuel oil cost $174 for 2900 gal., gas for cooking $52. Including equipment electricity, the total operating cost was $244.

The annual saving of $144 more than paid the interest and depreciation charges, and as the owner afterward said, "for the first time in five winters, I was comfortable in my own house."

Pump Saves Homeowner $300

The value of a pump in connection with hot water heating was well illustrated in another suburban residence, where both the boiler and supply mains were incorrectly sized. Although the house was of attractive design and well constructed, the builder had apparently realized his profit on the heating and plumbing installations, a not unusual occurrence.

Heating was by hot water, one main (a) supplying 655 sq. ft. of cast iron radiators, and the other main (b) 510 sq. ft. A connection from main (a) supplied the coil heater for the domestic water load, equivalent to about 200 sq. ft., thereby increasing the load on main (a) to about 855 sq. ft. As the oil fired cast iron boiler which had aquastat control was only rated to supply 1100 sq. ft. of cast iron water radiator, the load on both mains was about 24% in excess of the boiler rating.

A butterfly valve had been placed in each supply main at the boiler, with lever connections from one motor having thermostat control. The thermostat was located in a room heated by radiators connected to main (b) and as a result the rooms on the north side of the house, supplied from the overloaded main (a), were never satisfactorily heated.

As the owner planned adding a floor over his garage, on the north side, an additional tax of 230 sq. ft. would be placed on the north main (a), and the maximum boiler load would be 45% in excess of the boiler rating. The owner then asked for engineering advice.

A 2-in. water circulator was installed in the boiler return with a gate valve in each return main to balance distribution, the two motorized valves were replaced by single flow valves in the supply mains, a valved connection to the coil water heater was made from main (b), the thermostat was moved to the north hallway and connected by wiring for control of the pump, and a closed expansion tank was provided. The total cost of the work was $175.

The low figure to replace the existing boiler with a larger one, reinstall the oil burner, etc., was estimated at $355. In addition, had there been no pump, a larger main would have been needed to replace main (a), and the total cost of this work, including the new boiler, would probably have exceeded $475.

Using the pump, however, the house, including the additional floor, heated satisfactorily with the existing boiler. The saving credited to the pump installation might therefore be estimated at about $300.

The reduced use of fuel oil, shown in the table in the next column, was effected in a 12-story office building, first through the throttling of radiators in vacant offices, and later through the orificing of radiators. Thus, through throttling of radiation in vacant offices a 20% oil reduction was made, with another reduction of 23% after orificing.

The installed cast iron radiators totalled about 13,970 sq. ft. and the heated content of the building about 630,000 cu. ft., a ratio of 1 sq. ft. of radiator per 45 cu. ft. of heated content. As the building was well constructed, with metal weatherstripped windows,

Heating Season	Degree-Days	Gal. Oil	Gal. per Deg.-Day	Remarks
1931-32 (8-mos.)	3730	49,500	13.27	All radiators in use.
1932-33 (8-mos.)	4170	45,330	10.86	Radiators throttled in vacant spaces.
1933-34 (4-mos.)	2590	26,910	10.39	Radiators throttled in vacant spaces.
1933-34 (4-mos.)	2410	19,070	7.93	Radiators orificed.

9,500 sq. ft. of cast iron radiator should have been amply sufficient for the maximum heating requirements. Due to the 30% excess radiation, rooms became overheated in mild weather and as tenants generally raised windows instead of turning off radiators, waste of heat and fuel resulted.

The heating system was vacuum, with thermostatic traps at all radiators. The boilers were low pressure, steel tubular, equipped with semi-automatic horizontal rotary oil burners using no. 5 fuel oil.

All work of orificing was done by the mechanics employed at the building. The orifice discs were copper, about 0.031 in. thick, and cost $6.60 for 500. Each disc was molded to the required shape by being screwed down against a valve spud held in a vise. An electric drill was used to make the orifice holes, 8 to 10 discs being drilled at one time. The discs were then inserted in the union connection of each radiator supply valve. If, after a disc was installed, the heating of any particular space was not satisfactory, then another disc was substituted, with the orifice either increased or decreased in size, as required.

For a normal 4800 degree-day season, the total fuel oil saving, based on the difference between 13.2 and 7.9 gal. per degree-day, was about 25,400 gal., which at a no. 5 oil cost of 3¾ cents per gal., amounted to $950.

Combination Electric and Well Water System Cools Hotel

ONE of the most interesting applications of air conditioning in the northwest central states is under way in the Hotel Lowry, St. Paul. A General Electric system of 41 hp. is being installed in the hotel's cocktail lounge, terrace cafe, and terrace grill.

The installation is replacing a system of washed air ventilation which has been in use in the hotel for a number of years. This system, now considered overloaded, is being segregated to take care of the hotel's coffee shop and several small rooms.

Engineers for the Sutherland Air Conditioning Corporation, which is making the installation, were faced with a number of problems in the job, and finally worked out a combination of well water cooling, with additional cooling and dehumidification by mechanical refrigeration, which is expected to reduce operating costs.

The system is zoned so as to provide independent cooling for two subdivisions. In each zone, initial cooling is effected by low temperature water passing through counterflow coils.

Under conditions of additional temperature and humidity where this water cooling is sufficient, the rest of the equipment is idle, but whenever either zone requires additional cooling or additional dehumidification, these are automatically supplied by a two-speed, 15/7½ hp. condensing unit.

The management of the hotel plans to air condition additional space in the near future, and ultimately expects to provide year 'round conditioning in all of its public space, as well as many private suites.

How to Reduce Your Heating Costs†

By J. EARL SEITER‡

To appreciate fully the principles of heat conservation, it will be well to state briefly just what takes place in heating a building.

The process consists in supplying a sufficient quantity of heat to compensate for the dissipation or loss of heat, and to maintain certain uniform temperatures during the hours of occupancy. A heating system usually is designed to heat the building to 70° inside regardless of how low the outside temperature may fall. Under such conditions there exists a tendency to overheat the building at any time that the outside temperature is above 0°, unless some simple method of heat regulation is used. To do this efficiently, three things are necessary:

1. To reduce the heat losses from the building.
2. To limit the hours of heating to those in which the required temperature is necessary, and
3. To regulate the amount of heat so as to prevent overheating during the hours of occupancy.

Lexington Building, Baltimore, Md.

Reducing Heat Losses

These three points cover in general the principles to be applied in conservation of heat. To obtain the full benefit of the application of these principles it is necessary that the heating system be designed to get good distribution quickly and thoroughly throughout the system and that the heating system and its accessories be maintained in good operating condition.

A principal source of heat loss is through glass and is five times as great per unit area as through the average wall surface. Therefore, the installation of storm windows on all windows in corridors, stairways, and elevator shafts, where it is not necessary to open and close the windows, is recommended. The extra glass reduces the heat loss through the window about 50%.

Inasmuch as the warmest air in a building is at the top, roof losses are high. It is usually cheaper to properly insulate the roof than to make up the high losses with additional radiation.

There is also a certain amount of cold air entering a building around windows and through walls. Usually the amount of this air infiltration depends upon the size and number of the windows, as well as the type of windows. Some forms of sash allow an excessive amount of leakage to take place. Such leakage can be very materially reduced by the use of weatherstrips. They can be applied quite easily and their use shows by actual tests a saving of from 11 to 34% in the heating season's consumption of steam.

Often there is a considerable leakage between the windowframe and the building wall. These openings can be closed at a relatively small cost by calking at these points. Skylights, like windows, often leak around the frames. Drafts are caused by the cold air dropping to the floor. This downdraft can be remedied by the installation of heating coils, especially when the cost of operating the coils is considered.

Another source of infiltration is through the doors entering from the outside. Where there is a large amount of traffic, this becomes very heavy. The installation of revolving doors will reduce this loss materially.

In buildings having freight entrances and other openings where revolving doors cannot be installed, there is constant annoyance due to the continual opening and closing of these large doors, causing drafts to all sections of the floors. Most of this discomfort can be avoided and much heat saved by having vestibules on these entrances so that at no time would there be a direct opening between the inside and outside.

Reducing Ventilating Losses and Stack Effect

Ventilation is mentioned because it does have a decided effect upon the cost of heating, and is frequently looked upon as part of the cost of heating, whereas the cost of heating air for ventilation is chargeable to ventilation. The cost of heating air for ventilation can easily be twice the normal cost of heating the same space. This item, frequently overlooked, is important to building managers as a guide in fixing rents.

Ventilation is necessary in many cases, and in these

†Abstracted from a paper before the National Association of Building Owners and Managers.

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cases its cost is justified, but there have been millions of dollars spent installing ventilating equipment in buildings only to find that its operation was unjustified.

Ideas on requirements for ventilation have changed since many buildings have been built. It used to be considered proper to use 30 to 50 cu. ft. of outside air per occupant, but the present standards call for 10 cu. ft. of outside air per person. Under ordinary conditions the natural infiltration of air around windows is sufficient to supply this amount. Requirements for ventilation are considerably lower, therefore, than the general conception and where necessary should be localized to the particular portion of the building requiring it.

The unbalanced effect of heating between the upper and lower floors of tall buildings is due to the natural tendency of warm air to rise. Buildings having open stairwells and elevator shafts find this condition difficult to prevent and it frequently results in excess infiltration and resultant waste. In some buildings horizontal baffling has been accomplished at relatively modest expense, but in general it involves expensive changes of construction that are hardly justified by the advantage gained. Under such circumstances the tendency can be greatly retarded if care is taken to see that the penthouses and other roof openings are kept tightly closed and that as far as possible all windows on the upper floors are shut.

Limiting Hours of Heating

The temperatures necessary in buildings are quite different for day operation and night operation. A day schedule must be maintained which will keep the inside at a comfortable temperature whenever there are occupants in the building. On the other hand, the only heating normally necessary at night is to maintain the inside temperature from 40° to 60°. Because the rate of heat transfer from the building varies directly as the difference in temperature between the inside and outside, the lower the inside temperature the lower the heat loss and heating costs.

The greatest economy in the consumption of steam can be effected by shutting off the heating system at night and on holidays. Steam should be turned off as early in the evening as the use of the building will permit, and should not be turned on again except in extremely cold weather. Steam can be turned off in the evening somewhat in advance of the time when a drop in building temperature is permitted because the radiators will give off heat for a time. In mild weather the building temperatures will drop slowly and steam can be turned off earlier than in the cold weather.

A study of your own building with recording thermometers will establish the rate of cooling and heating-up for various outside temperatures and a schedule can easily be prepared for turning steam on and off the building. Following is a typical schedule for an office building providing service from 8 a.m. to 11 p.m.

Working on this basis the building for which this table was prepared effected a saving in steam of

SCHEDULE FOR HOURS OF HEATING

Outside Temperature	Turn Steam On	Turn Steam Off
0°	Steam on Continuously	——
10°	11:00 p.m.	6:00 p.m.
20°	1:00 a.m.	5:00 p.m.
30°	4:00 a.m.	4:00 p.m.
40°	6:00 a.m.	3:00 p.m.
50°	7:00 a.m.	10:00 a.m.
	1:00 p.m.	3:00 p.m.
60°	7:30 a.m.	9:00 a.m.

14,000,000 lb., or over 26%, the first year it was applied. Where sections of the building require heat at times other than the main building, it saves money to provide a separate line to supply these special requirements.

Temperature or Heat Control

Heat losses from a building change with every change in outside temperature. Perfect heat control requires that the amount of heat supplied to the building be adjusted to correspond with every shift of outside temperature.

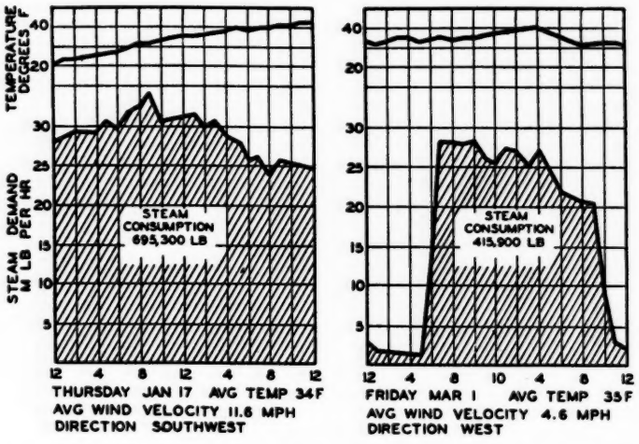
In general, the duration of the extreme low temperature in any community does not prevail over 2½% of the total time that heating is required in a year. It is perfectly obvious that during the remaining 97½% of the time the heat delivered to the building must be retarded, or in some way controlled, to prevent overheating and resultant waste. That is to say, unless some means is used to control the delivery of heat from any heating system, heat will be used at approximately the same rate at moderate outside temperatures as during the extreme low temperatures.

It is fully possible with an average outside temperature of 47° to waste 67% of the heat used in a building. Now isn't it reasonable to believe that with such wastes possible every effort should be made to provide necessary facilities to eliminate them, then to see that these facilities are continuously and effectively used to the best advantage? Your answer would undoubtedly be yes, yet we still find people who are not fully in accord with the new developments and who hesitate to change their operating practices. They realize that no single comfort standard can be laid down which would meet every need and condition. There is an inherent individual variation in the sensation of warmth or comfort felt by persons when exposed to an identical atmospheric condition and they believe that many people desire open windows in order to provide ventilation and to control their own temperatures to satisfy their own desires. These are all sound arguments and deserve consideration.

Let me point out that excess window openings are not usually the result of a need for ventilation but are the need for relief from overheating within the building. Time and again it has been proved that the seeming necessity for this open window ventilation quickly vanishes when the heating system of the building is brought under control and the temperatures are maintained within the comfort range. Tenants do not de-

sire to bother with opening windows if they can avoid it.

Further, outside air in congested business or industrial areas is contaminated by dust, fumes, gases, and smoke which are harmful to buildings and the health of the occupants. It is this dirt coming in through open windows which causes much of the cleaning and maintenance expense, and it is this contamination that aggravates respiratory disorders. Outside air as it filters through irregular cracks around closed windows deposits a large portion of the destructive elements before entering the building and if much less air is admitted it reduces to a minimum the harmful effects upon a building and its occupants.


TEMPERATURE DEGREES F
STEAM DEMAND M LB PER HR
STEAM CONSUMPTION 695,300 LB
12 4 8 12 4 8 12
THURSDAY JAN 17 AVG TEMP 34 F
AVG WIND VELOCITY 11.6 MPH
DIRECTION SOUTHWEST
STEAM CONSUMPTION 415,900 LB
12 4 8 10 4 8 12
FRIDAY MAR 1 AVG TEMP 35 F
AVG WIND VELOCITY 4.6 MPH
DIRECTION WEST

Load curves for office building, showing saving by shutting off steam at night

One more benefit of temperature control is the elimination of fluctuating building temperatures. These fluctuations of temperatures may be caused by manipulation of radiator valves, by opening and closing of windows, by uneven firing, or many other causes. Health authorities suggest that fluctuating temperatures favor bacterial activity and play an important part in the inception of the common cold and other respiratory diseases. Further, working in an overheated room results in mental fatigue, whereas with suitable temperature conditions the mind is alert and the individual capable of greater accomplishment.

Modern temperature control assures benefits which, briefly summarized, are:

For the Building Owner:

1. Saves money by reducing heating expense;
2. Saves money by reducing cleaning and maintenance expense;
3. Promotes the peace of mind and the goodwill of tenants;
4. Raises the prestige of the building;
5. Will increase the revenue from the building.

For the Tenant:

1. Obtains more efficient work from the employes;
2. Reduces the amount of sickness;
3. Provides greater comfort and peace of mind;
4. Makes possible cleaner and more pleasant surroundings.

What can be accomplished by a careful survey of conditions and the application of the principles for conservation of heat is very apparent in the results obtained in a building having approximately 5,500,000 cu. ft. of space, and 68,000 sq. ft. of radiation. The first floor is ventilated on the upper floors, vitiated air is removed by an exhaust system. Portions of the building are used 24 hr. per day and on Sundays. This building used approximately 32,800,000 lb. of steam per season. Radiators were turned off at night by the charwomen and on again by a watchman. About 60% of the space was occupied from 8 a.m. to 11 p.m., and the balance from 8 a.m. to 6 p.m.

During the first year of the study, separate lines were installed to the various sections of the building requiring heat 24 hr. per day. The portion of the heating system in the building operated from 8 a.m. to 6 p.m. was segregated from the balance of the system. Steam was shut off completely on the various sections when they were not occupied. The steam consumption dropped from 32,800,000 lb. to a little more than 21,100,000 lb.

During the second year further corrections were made to improve the circulation in the heating system. These small adjustments resulted in a further reduction of nearly 700,000 lb.

The third year temperature control was installed, and the steam consumption dropped to 16,840,000 lb.

The fourth year, with better experience in operation, and a few minor changes in the control equipment, a further reduction to 13,400,000 lb. was obtained.

During the fifth year, and the third of the control installation, the condensate from the heating system was used in the ventilating coils and further improvements were made on the control equipment with a further drop to 12,100,000 lb.

These changes resulted in a total drop in steam consumption from 32,800,000 lb. per year to 12,100,000 lb., a reduction of over 60%. Heating conditions were greatly improved and the health record of the building, of which an accurate record was kept, showed a decided improvement.

There was a marked drop in cleaning and maintenance expense, and much praise for the improved heating conditions instead of the complaints formerly received. It improved the goodwill of the tenants and the building is much more comfortable than previously.

The cost of the changes amounted to approximately $18,000 and this cost was saved in a few years.

It is not always necessary to spend a great deal of money on equipment to make savings, especially if the heating system is in good condition. Shutting off at night requires no capital outlay and some degree of temperature control can be accomplished by manual operation of the steam supply valves. The cost of calking around windows usually pays for itself in reduced cleaning and painting costs. If a vacuum system is installed in the building, the temperature of the steam in the radiators and heat emission from them may be substantially reduced by maintaining vacuums

as high as possible at the reducing valve and in the radiation. Manual operation requires strict supervision of building temperature. This always pays.

There are many systems of automatic temperature control on the market, and if the savings possible warrant the installation, the manufacturers in many cases are willing to receive payment out of the actual savings obtained.

With any type of control equipment a careful engineering survey of the system should be made. This is usually done by the manufacturer's local representative.

A great deal of the success of any installation depends upon the service organization and the engineering ability of the manufacturer's agents. Prompt servicing of any type of equipment installed to save money is very important, as periods when the equipment is not in service may result in considerable waste. After a control is installed some existing defects in the system are going to show up. This is an advantage because defects which can be overcome by increased pressure differentials across the system result in a waste of steam. It is often the case that these defects cannot be localized until the control system is installed.

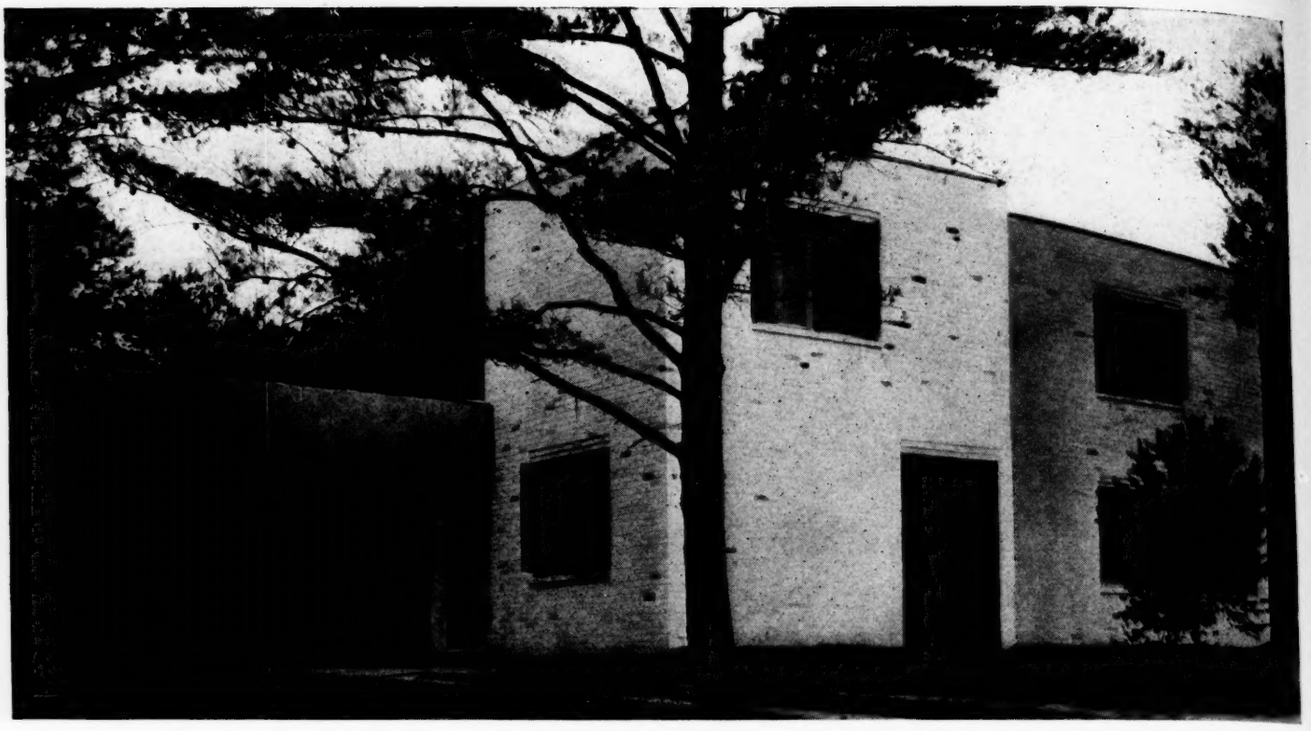
Cooling a Railway Car

LET us consider a well insulated coach in which we wish to put equipment to maintain a temperature of 78° and 50% relative humidity inside with an outdoor temperature of 95°. Such a car would be of the type ordinarily known as a de luxe model coach with double glass windows, three-ply felt insulation under the roof and on the inside of the outer steel walls, and an equivalent heat protected flooring. How much air should be circulated in such a car and what would be the necessary tonnage rate for the cooling conditions indicated? Obviously, the necessary tonnage rate is directly dependent upon the heat loads so that before a solution to the problem can be evolved the heat loads must be determined. A tabulation of the load follows:

GROUP 1—DRY HEAT	
Actual heat conducted through the walls, roof, and floor of a car	15,130 B.t.u. per hr.
Added heating effect resulting from absorption of sunlight radiation	5,870 B.t.u. per hr.
Dry heat developed by 80 passengers at rest and exposed to 78° ambient temperature	20,000 B.t.u. per hr.
TOTAL DRY HEAT	41,000 B.t.u. per hr.
GROUP 2—LATENT HEAT	
Heat equivalent of moisture from perspiration and breath of 80 passengers at rest and exposed to 78° ambient temperature	12,000 B.t.u. per hr.
Actual moisture to be condensed to equal this heat value	0.191 lb. per min.

In the summation of heats for group 1 no allowance was made for the heat generated by lights or other electrical equipment in the car. It should be borne in mind, however, that the lights are never on while the sun is exerting its full effect and other sources of heat are usually negligible. The segregation of these quantities into two groups of heat values of an entirely different physical nature enables us to construct an aerograph and balance by the principles of superposition the necessary temperatures, dewpoints and air volumes. We can so definitely establish the fact that 1870 c.f.m. of air must be introduced into the car at a temperature of 57.9° dry bulb and 55.2° wet bulb to maintain the car temperature at 78° dry bulb and 65° wet bulb or 50% relative humidity. The usual practice in designing systems for passenger car air conditioning indicates that 25% of this air or 468 c.f.m. must be filtered and drawn from the outside and 75% recirculated from the car itself through suitable recirculating air filters. In many cases this percentage of outside air is inadequate to retain the sensibility of freshness in the car and the outside air proportion must be increased to 40% or more. Making use of the 25% outside air practice, however, and computing the tonnage rate we arrive at the conclusion that a maximum mechanical tonnage rate of 6 tons of ice melting capacity for 24 hr., or 72,000 B.t.u.'s per hr., must be supplied.

Obviously the increased tonnage capacity of the unit over and above the summation of heats tabulated under groups 1 and 2 (i.e. 41,000 B.t.u. per hr. plus 12,000 B.t.u. per hr.) is directly accountable to the introduction of 468 c.f.m. of 95° hot humid outside air and the necessary loss of an equal volume of 78° cooled air by leakage from the car to establish a continuity of flow. Reconstructing these figures on a percentage basis it develops that of the total heat represented by 6 tons per 24 hr. of ice melting capacity only 26.4% (1.75 tons per 24 hr.) is developed by wall radiation and sun effect in a car of this type. Consequently any improvements in the insulation of the walls and roof must influence only 26.4% of the total tonnage rate of the system as a whole. It is possible by increasing the felt thickness to 2 in. to cut the coefficient of heat transfer through the walls and roof of the car in half. If this were done the effect would be to reduce the total tonnage rate by 13.2%, bringing the car's tonnage down to a figure of slightly less than 5¼ tons per 24 hr. of refrigeration.—*Abstracted from an address by S. M. Anderson before the Air Conditioning Bureau, Boston.*



One of the two air conditioned Berloy Steel-Frame houses erected recently in Washington in about a month's time.

Steel Frame House Features Year 'Round Air Conditioning

A NEW development in the search for an inexpensive modern dwelling is the Berloy Steel-Frame house. Unlike the prefabricated house, only the framework and the mechanical equipment of this steel frame dwelling are fabricated at a central plant. The exterior may be finished in any building material—brick, stucco, stone, clapboard or shingles—while the interior can be of wall board, lath and plastering, wood paneling or paper. Any style or shape of roof can be used on the steel frame with practically any roofing material.

It is claimed that by this method of construction an extremely modern dwelling can be erected in about one third of the time it ordinarily takes to erect an ordinary house and at the same time it provides a better constructed and cheaper house.

The main feature of the structure is the fabricated steel frame or skeleton. This skeleton is an assembly of frames fabricated from high quality strip steel into 3-ft. sections of the desired ceiling height. There are three standard frames, one for the doors, one for the windows, and one for the solid walls. Since they are all of the same width, the door and window sections are interchangeable with the solid wall sections, making possible extreme flexibility in construction.

The rectangular steel frames are simply bolted to the foundation and to each other, forming a rigid and continuous steel framing for the house. Floor and roof framing of metal joists are bolted to the rectangular steel wall units.

Another unusual feature of the structure is a steel frame or chase containing the water service piping, building drains, sewer and gas connections, and flues for the house and water heating apparatus. This equipment is incorporated in a standard wall frame at the factory so that the systems are quickly installed in their completed forms at their proper location while the steel building framing is being erected. This unit becomes part of the building wall and entirely eliminates running pipes through the walls.

All of the valves for the water supply and the controls for the air conditioning system are included in this panel. These valves and controls are easily accessible by means of a door under the sink.

The bathroom is made up of five primary units which are easily handled and quickly assembled. These include a bath with shower, lavatory, water closet with concealed tank, medicine cabinet, towel closet, and two large storage cabinets. Removable panels are provided so that all parts of the water supply and drainage systems needing inspection and repair are easily accessible. All of the cabinets are fastened to-

gether and form a rigid integral assembly securely fastened to the frame of the house.

The kitchen equipment includes an air conditioning unit, a water heater, a combination sink and laundry tray fixture, a table top refrigerator, a table top gas range, closets and cupboards. The gas range, sink and laundry tray fixtures and refrigerator are arranged to provide a table height continuous working surface.

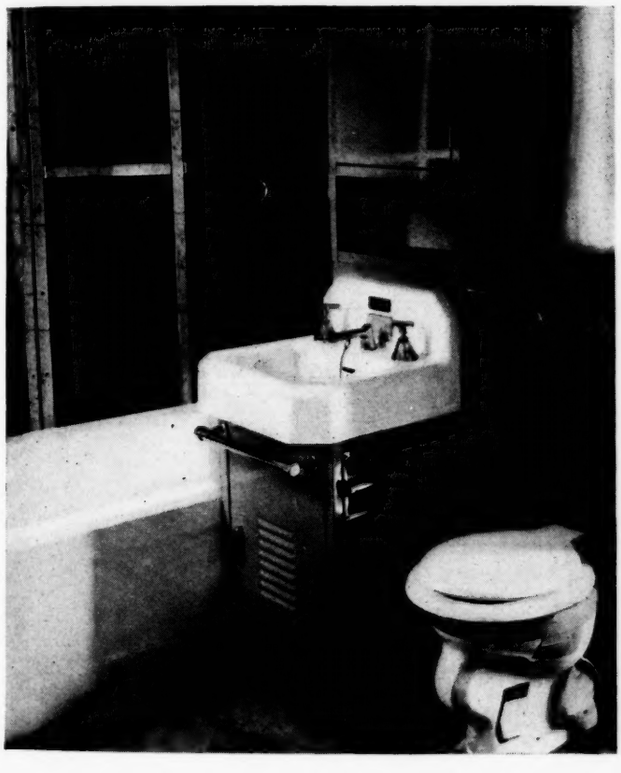
Heating Equipment

It is stated that any type of heating equipment may be used in this house, the choice depending on local conditions and the preference of the owner. In the first of these houses which was erected in Washington it was decided to install gas for heating.

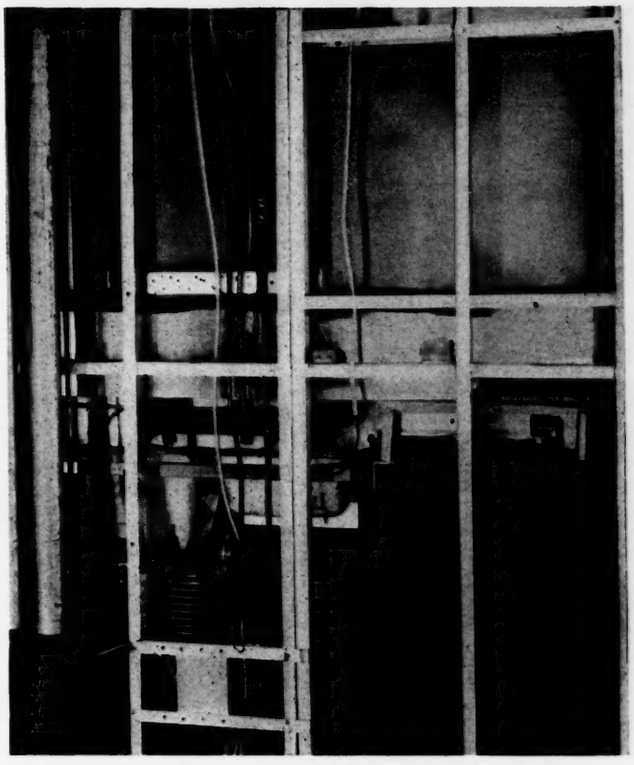
The heating unit selected occupies about the same space as an ordinary kitchen stove and contains not only the furnace but a fan for air circulation and an instantaneous hot water heater as well as the air conditioning facilities.

The air conditioning and hot water heating units are combined in an enamelled steel cabinet 20 in. by 36 in. which extends from floor to ceiling and is placed in a corner of the kitchen. Included in this cabinet are a special forced air heating unit with a filter located in the circulating intake, a fan and motor, and a water spray chamber.

The air to be conditioned is filtered as it comes through the intake. It is then forced by a squirrel cage fan over the heating surface which is made up of 14 cast iron tubular sections, each with an individual gas burner. The burners and valve and gas control



Compact cabinet assembly for the bathroom before wall covering was applied.



Standard steel frame or chase containing all piping, drains, gas connections and flues.

assembly are combined so that the entire unit is easily removed for inspection and repair. A series of baffles are provided in this section to increase the heating efficiency.

After passing over the heating surface the air enters the water spray chamber where it is humidified in the winter and dehumidified and cooled in the summer. It then travels through the main circulation duct which extends across the ceiling of the kitchen for the full width of the room. The air for the first floor rooms is carried through ducts located in ceiling joists over the first floor and enters the room through ceiling grilles. Vertical ducts run up through the closet spaces carrying the air to wall registers located near the ceiling of the second floor.

A novel feature in the air circulation system is the use of the steel framing of the house for circulation of the exhausted air from the room. A continuous baseboard exhaust register is located on all outside walls which communicates through wall and floor passages to a space below the first floor where the recirculated air is drawn into the intake of the air conditioning unit.

It is claimed that the circulation of the air through the walls and floors eliminates chilly floors and walls and makes the rooms more comfortable. No air from the bathroom or kitchen is recirculated.

During the heating season an unusual use is made of the air exhausted from the bathroom and kitchen. The exhaust grilles are connected to the gas heating furnace so that this air is used for burning the gas. The flue gases are exhausted through a steel smoke stack built into the steel framing of the house.

GETTING DOWN TO FUNDAMENTALS

5—Legal Requirements for Ventilation Air

Foreword

IN previous articles in this series the nature and direction of flow of the heat quantities on which the usual estimate is made have been described. They were shown to be divisible into (a) transmitted heat, (b) heat from filtration air, and (c) heat from ventilation air. It was also noted that these quantities can be expressed mathematically in the following equations:

$$\text{Transmitted Heat} = H = AU\ (t_i - t_o) \quad (1)$$

$$\text{Heat from Filtration Air} = F = \frac{C(t_i - t_o)}{55} \quad (2)$$

$$\text{Heat from Ventilation Air} = V = \frac{C_v(t_i - t_o)}{55} \quad (3)$$

In these equations: H, F, and V are all in B.t.u.'s per hour:

A = Area, sq. ft. of surface through which heat passes
U = The transmission coefficient, air to air
C = Volume of filtration air flowing, cu. ft. per hr.
C_v = Volume of ventilation air flowing, cu. ft. per hr.
t_i = Temperature of indoor air, °F.
t_o = Temperature of outdoor air, °F.
$1/55 = 0.018$ = heat to raise 1 cu. ft. of air at 70° through 1°

It was also noted that the three equations are not usable until values are available for substituting in them. Tables giving suitable values for t_i and t_o were also presented, as were tables for selecting values for C in equation (2).

In last month's article on "Estimating the Amount of Ventilation Air Necessary," the underlying reasoning fixing values of C_v in equation (3) was outlined and a table was included giving the amounts of ventilation considered necessary in various types of buildings. This table, while believed to be the most complete of its kind ever compiled, does not fully meet the needs of the man who is trying to fix upon suitable values of C_v, the amount of ventilation air passing through the building at peak operation. What it really contained were the amounts as reported to be required by various authors, presumably gleaned from their own experiences.

Experience figures showing the amounts of ventilation air necessary can be made useful if they can be narrowed to the point where they can be made to fit particular cases. Selection from figures giving a range of values requires considerable experience and judgment on the part of the user. There are other ways of fixing the amounts, however, and we can now examine data resulting from them.

One method is to set up the amount by statute, ordinance, or similar legal enactment. The amounts as set by this method may originally result either from practice or from some rule, and commonly take the form of a minimum quantity. The designer is free to use any quantity greater than this minimum but the tendency so far as ventilation air is concerned is to regard the specified minimum as the amount to be used.

In general there is little or nothing to prove that the minimum quantities as fixed are necessarily correct or defensible. Arguments on this point are beside the point, though, for where these quantities are fixed their use cannot be avoided without running the risk of the penalty or else getting permission to make an exception. Since the estimator or designer bears responsibility for seeing that his figures are in accordance with legal enactments, he is assumed to know of these where they exist.

The great majority of such enactments on ventilation air are couched in very general terms and consequently do not set up definite figures. On only one class of buildings have the quantities been specified reasonably closely and rules of practice laid down. These are school buildings, especially public school buildings. In some few cases quantities are specified for use in factory buildings and in department stores and theaters.

School and Industrial Buildings

It is troublesome and almost impossible to check accurately on local enactments both because of their being continually changed and because of the multiplicity of names by which the administrative bodies are known. It is possible, though, to get a fair summary of the state laws dealing with ventilation air quantities in both public school buildings and in factories. Fortunately, in most states the state laws cover the situation. In a few, however, counties or cities draw up their own requirements and do so more or less informally. In many states the larger cities are exempted from the terms of the state laws. Table 1 summarizes the quantities and the principal requirements for school and industrial buildings.

To a certain extent requirements set up in this table serve to clarify and narrow the range of figures given in general terms in the preceding table but there are still several difficulties in applying them. One is that the degree of recirculation permitted must be taken into account in estimating peak heating load. If full recirculation can be practiced during the days of seasonal peak requirements, then the quantities fixed serve to form a basis for sizing ventilating equipment, ducts, motors, and similar items but would not enter an estimate for determining peak heating or cooling requirements. A second difficulty in application is that the quantities fixed, while binding where they are in force, have been so seriously questioned in recent years that there are large numbers of people who would not regard them as currently justifiable. Another difficulty is the necessity of knowing the attitude of enforcement agencies toward the laws, for in some cases the re-

TABLE 1. AMOUNT OF VENTILATION AIR REQUIRED FOR SCHOOLS AND GENERAL INDUSTRIAL BUILDINGS
(As Fixed by State Laws in the Several States)

State	Ventilation Air* Cu. Ft. per Hr. per Person (C_v)	Remarks
	Public School Buildings *(Classrooms Unless Otherwise Noted)*	
Idaho	1800	Use of direct radiators in classrooms not permissible. No mention of recirculation.
Indiana	1800	Specifies 1800 cu. ft. of *fresh* air, but notes that used air may be reheated if state Department of Health approves system of reheating and washing.
Louisiana	1800	Both state and local officers approve plans. No mention of recirculation.
Maine	1800	Specific mention of separate foul air ducts to remove air at the rate supplied to each room.
Massachusetts	1800	Direct radiators may supply heat to 50° at zero outside. Specifically calls for *fresh* air and for definite removal of like amount. Partial recirculation permitted in rooms where there are washers and automatic temperature control, subject to approval in each case. Fume exhaust required in chemical laboratories. Assembly halls and gymnasiums—not less than 2½ c.f.m. per sq. ft. of floor area; 1½ cu. ft. per sq. ft. of floor area in gymnasiums, locker rooms, and emergency rooms.
Michigan		No direct statement about quantity, but recirculation for economy permitted. Air filters and washers may be used.
Minnesota	1800	Also no system approved which does not renew the air at least four times per hour. Recirculation up to 75% permitted while building is in use if proper air washer or filter is installed. When not in use, recirculation advised regardless of presence of filter or washer.
Montana	1250	Also not less than 250 cu. ft. of classroom volume per student. Specifies *fresh* air. If not more than 200 cu. ft. of space per student, air must be changed not less than five times per hour.
New Jersey	1800	Air is *fresh* air, by inference.
New York	1800	Specifies *pure* air. Also mentions not less than 35% R. H. Recirculating devices not considered as meeting the requirements of law.
North Dakota	1800	Exhaust facilities also required.
Ohio		Classrooms, assembly rooms, toilets, not less than six changes per hour. Other spaces, three changes.
Oklahoma	1800	Mentions *fresh* air, and specifies the quantity in cold weather.
South Dakota	1800	When temperature difference between indoor and outdoor is not less than 30°.
Texas	1800	Classrooms and study halls to be supplied with *fresh* warm air; also adequate exhausts.
Utah	1800	Classrooms, 1800 cu. ft.; assembly rooms, 1500 cu. ft.
Wisconsin	2 c.f.m. per sq. ft. of floor area	50% recirculation permitted during occupancy with screens at inlets; 75% when dust eliminator is operated in air supply circuits; 100% when building is unoccupied. Corridors and halls not less than ½ c.f.m. per sq. ft. floor area. Air to be properly humidified.
	Industrial Buildings *(General)*	
Illinois	1500 to 1800	Health, Safety and Comfort Law requires that factories or workshops having between 500 and 2000 cu. ft. of air per person shall supply *fresh* air at rate of 1500 cu. ft. per hr. per person in weather when temperature is too low to permit opening of windows, provided that such factories shall have outside door and window openings equal to not less than one-eighth the floor area. If less than this amount, then 1800 cu. ft. of fresh air per person.
Ohio	60 cu. ft. per hr. per 2 sq. ft. of floor area	Where cubage per occupant is less than 400 cu. ft. or where natural ventilation is impossible.
Wisconsin	60 cu. ft. per hr. per sq. ft. of floor area, and not less than 1800 cu. ft. per hr. per occupant	Specified for certain limited classes of industrial buildings and to be in addition to any air necessary to make up for process contamination. Code under direction of Industrial Commission.

*Recirculation assumed not permissible unless noted.

TABLE 2. AMOUNT OF VENTILATION AIR REQUIRED FOR VARIOUS TYPES OF OCCUPIED ROOMS

(As determined by rules in proposed building code for New York, 1932)

1. Where excessive heat may be created to the detriment of the occupants, or where steam, gases, vapor, dust or other impurities in the air, which may be injurious to health, may be generated in the course of commercial activities, rooms shall be ventilated in such manner as to render them harmless to any person therein.

2. Spaces below grade without windows, and designed for human occupancy shall have a mechanical means of ventilation of at least 50 cu. ft. per person per min., and at least four changes of air per hour, with provision for a corresponding air inflow from an uncontaminated source.

3. Every bathroom, toilet room or other room containing one or more water closets or urinals, hereafter placed in any structure, shall be ventilated in at least one of the following ways:

(a) By a window, opening to a street, yard or court of lawful dimension and having a clear ventilation area of at least 5% of the floor area, but at least 3 sq. ft. and a width of at least 1 ft.

(b) By a window of the size specified in 3*(a)* opening on a vent shaft which extends to and through the roof, or into a court of lawful dimensions and which has a cross-sectional area of at least 1/5 of a sq. ft. for every foot of height, but at least 9 sq. ft. and, unless open to the outer air at the top, a net area of louver openings in the skylight equal to the maximum required shaft area.

(c) By an individual vent flue or duct extending independently of any other flue or duct to and above the roof and having a cross-sectional area of at least 1 sq. ft. for one or two water closets or urinal fixtures and 1/3 of a sq. ft. additional for each additional water closet or urinal fixture.

(d) By a skylight in the ceiling, having a glazed surface of at least 3 sq. ft. and arranged so as to provide ventilating openings of at least 1½ sq. ft. to the outer air above the roof of the structure or into a court or yard of lawful dimensions, for one or two water closets or urinal fixtures and 1 sq. ft. additional for each additional water closet or urinal fixture.

(e) By some approved system of mechanical exhaust ventilation of sufficient capacity to exhaust at least 40 cu. ft. of air per min. per water closet and per urinal for public toilet rooms, and at least 25 cu. ft. per min. for private interior bathroom.

(f) Interior bathrooms and water closet compartments shall have openings from adjacent rooms or corridors ample to provide a sufficient inflow of air to make exhaust ventilation effective.

(g) The use of pipe shafts as ventilating shafts is forbidden and such pipe shafts shall be floored over solidly at every third floor. Separate exhaust flues shall be provided for every 250 ft. of height of structures, and these flues shall be of approved construction.

4. Inside locker rooms and rooms of similar usage shall be provided with exhaust ventilation giving at least two changes of air per hour.

5. Refrigerating plants shall be ventilated in accordance with the rules and regulations of the Fire Department.

6. Inside spaces where cooking of any kind is done shall have a mechanical exhaust ventilation of at least 150 cu. ft. per min. The exhaust shall be collected in a sheet metal flue connected to an independent common flue in a fireproof shaft. Such flues shall be of No. 16, United States gage sheet steel, or terra cotta, and shall be connected to a separate fan.

7. Spaces above grade, with or without windows, designed for human occupancy only, shall have ventilation either from windows or from mechanical means, or from both, in accordance with the following index and requirements:

Cubic contents per person plus 10 times floor area per person plus 100 times the entire window frame opening per person equals Index.

For Rooms with Windows

(a) If the Index is less than 300 there shall be supplied an amount of fresh air equal to 2½ cu. ft. per min. per sq. ft. of floor area, and an air exhaust of 2 cu. ft. per min. per sq. ft. of floor area.

(b) If the Index is between 300 and 520 there shall be supplied an amount of fresh air equal to 2 cu. ft. per min. per sq. ft. of floor area, and an air exhaust of 1½ cu. ft. per min. per sq. ft. of floor area.

(c) If the Index is between 520 and 850 there shall be supplied an amount of fresh air equal to 1½ cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1¼ cu. ft. per min. per sq. ft. of floor area.

(d) If the Index is between 850 and 1650 there shall be required an air exhaust only of 1 cu. ft. per min. per sq. ft. of floor area.

(e) If the Index is above 1650 no ventilation is required.

For Rooms without Windows

(a) If the Index is below 850 the requirements shall be the same as for rooms with windows.

(b) If the Index is between 850 and 1650 there shall be required an air supply of 1 cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1 cu. ft. per min. per sq. ft. of floor area.

(c) If the Index is over 1650 there shall be required an air supply of 1/3 cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1/3 cu. ft. per min. per sq. ft. of floor area.

(d) Interior partitions shall have transoms or equivalent openings, and when partitions occur 30 ft. or more away from a window or similar opening the room so formed shall have ventilation based upon the Index without windows.

8. Spaces below grade with or without windows, designed for live storage of four or more gasoline propelled cars operated within the storage space under their own power, shall have at least four changes of air exhaust per hour by mechanical means, with provision for a corresponding air inflow from an uncontaminated source. Two changes of the four shall be taken from near the floor.

Spaces above grade with or without windows, designed for the same purpose, shall have openings near the floor on all outside and court walls. These openings shall be at least 6 in. x 4 in. and within 6 in. above the floor, and shall be spaced between wall columns and at least every 16 ft. where columns do not occur. Such spaces shall also be subject to the requirements of (1).

Pits below floor levels shall have mechanical exhaust ventilation taken from near the bottom of the pits.

quirements are not mandatory and the enforcement agency is allowed considerable leeway in their interpretation.

Industrial Dust and Gas Removal

In many states there are factory laws which require that dusts, fumes, and gases from processes be removed at the source where their presence may result in possible injury to workers. Such laws virtually without exception are drawn in general terms and specify the result desired without including specific data as to how it shall be accomplished. Mechanical exhaust methods are often necessary. While there are certain rules which may be helpful in estimating the amount of ventilation air required to accomplish these results, they are not given here because of the space required, the specialized nature of the problem and the confusion now surrounding the performance deemed necessary, and the actual performance obtainable in such installations. Movements are currently under way to remedy this situation. It is notable though that where exhaust systems for removal of dusts, gases, or fumes are present they require air, and that failure to allow for it is a frequent cause of dissatisfaction in industrial building installations.

City Ordinances

City laws and ordinances on building construction have been greatly influenced and guided by the work of the Department of Commerce on this subject. The model code put out by this department does not contain any specific recommendation as to air quantities required for ventilation. As a result many cities are without ordinances covering this item for they have enacted the model code verbatim. In some of the larger cities specific ordinances, or delegations of authority to sanitary departments or boards of health, have resulted in quantitative requirements being set up for various types of buildings and rooms. The practice of requiring plans to be submitted to city departments before permits are issued is general. The scrutiny given to them and particularly to the amounts of ventilation air to be used varies greatly.

Theaters, schools, auditoriums, department stores, public garages, and toilets are commonly included where quantities are fixed. For theaters and schools the quantity most often given is 25 c.f.m. per person, although there are reported cases where as little as 20 cu. ft. are required. Toilets are most generally fixed at four changes per hour. In general, there is little agreement between cities either on practices or quantities. Neither is there a good chance of knowing in advance the current rules or the degree to which enforcement is carried in any particular city. Since summer cooling of theaters with recirculation has become popular there is less emphasis on the amount of ventilation air considered necessary in these buildings. Specific inquiry is usually necessary to learn current rulings, if any.

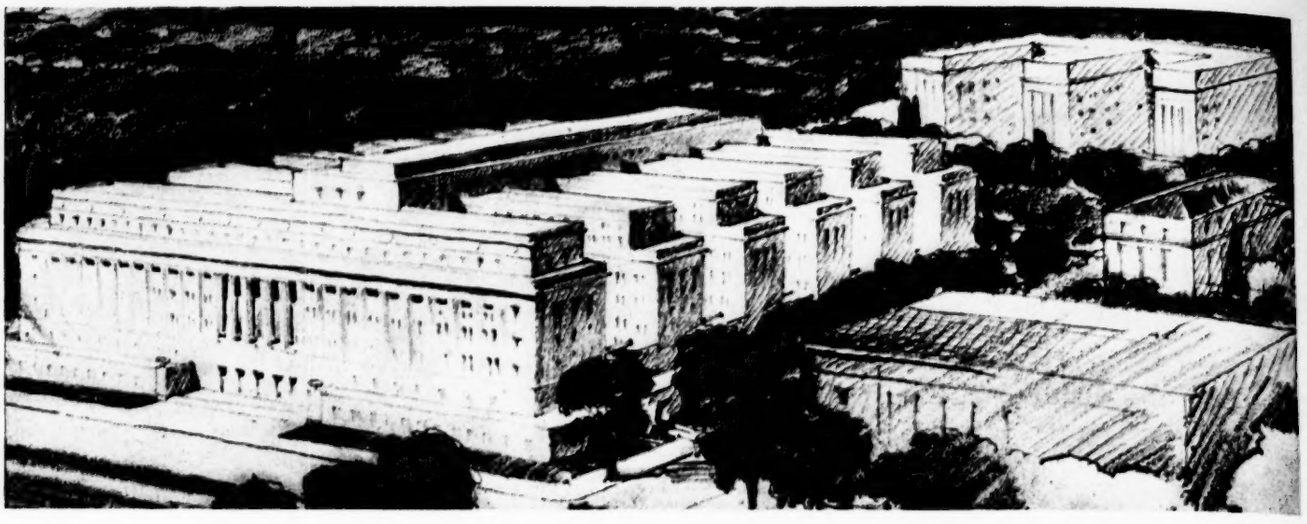
In the case of state laws, comments were made about the complication which the attitude toward recirculation of air at peak introduces into attempts to fix peak estimates. These same comments apply equally, or even more forcefully to city ordinances. Unless the situation surrounding the degree of recirculation permitted is known, fixing of the amount of ventilation air required does not fully answer the question of what allowances are to be made in calculations to arrive at peak load for estimating purposes.

With the falling off of new building construction there came a lull in the formal work of drawing up building codes, a work which had gone on actively for some years previous. As a result but few building codes have been prepared in late years. A comparatively recent one, and one which had the benefit of much expert assistance in its preparation, was proposed for New York in 1932. This code has never been adopted and consequently its rules are not in force. It contains a set of rules for determining the amounts of ventilation air to be used in various types of buildings. The code was intended to apply to both public and private buildings.

Even though these rules are not legally in force, and may never be, they are closely related to legal enactments and a summary of them is included (Table 2) both because they represent a recent attempt at drawing up rules for city enactment and because of the fact that they offer a basis of arriving at numerical figures with some exactness instead of giving a wide range of limiting quantities. The engineer or designer is concerned with getting a specific rule which will let him set his quantities with some exactness. For this reason he is likely to look with favor on a set of rules drawn up in the general form shown in Table 2. At any rate this proposed code offers a model of form on the subject of ventilation air quantities which would eliminate some of the existing confusion and which could be amended as ideas develop.

As a result of examining the possibilities of narrowing the extremely wide range of air quantities as set up by textbooks and similar sources by resort to the quantities fixed by laws and legal enactments, it is evident that these laws are by no means an unfailing solution. Moreover, their requirements apply to buildings of a kind where the range of quantities as given by the published works of authorities is not especially confusing. They are of little help in the cases of industrial process users of ventilation air where the range of published quantities is particularly great. They do not answer the riddle of suitable allowances to be made at times of peak operation which is the time of greatest concern to the estimator. The varying interpretations put on the requirements by enforcing agencies add to the confusion rather than lessening it. On the other hand, these requirements have no doubt been helpful on occasion. At any rate they must be considered. There is no doubt either that fairly simple rules fixing the quantities could be drawn up, but whether they could be put into successful use or not is an open question.

It still remains true that with whatever help is available from existing laws the element of judgment is still present and of the utmost importance in estimating quantities of ventilation air.



1900 Tons of Refrigeration for New Interior Building

ONE of the most extensive air conditioning systems ever installed in a federal government building in Washington, is contemplated for the new Department of Interior Building, bids for which were opened on July 26.

The air conditioning system called for by the specifications includes the refrigeration machines, all necessary pumps and piping, water piping and connections, fans, motors, air heaters, filters, dehumidifiers, tanks, fans, sound installation, individual air conditioning units, necessary ductwork and covering, condenser, water coolers, automatic controls, certain electric wiring, indicating and recording instruments, and incidental items. It is intended that the system shall insure complete and satisfactory air conditioning for the entire building.

Fans, dehumidifiers, and distributing ducts are to be located in the mechanical floor space which lies between the fifth and sixth floors. In general a cold air supply riser is run down and up concealed alongside one column in each of the bays of all exposed wall on all floors. Each riser supplies air to the air conditioning unit located under the window adjacent to it. Return air passes to the corridor through louvers in the doors and is carried back to the dehumidifiers through vertical return ducts. There are some exceptions to the scheme. Fans and dehumidifiers for the extreme east and west portions of first and second floors, for the library, stack, auditorium, and cafeteria are located in the basement. Supply to rooms on the penthouse floor is from register faces located close to the ceiling.

The chilled water cooling equipment is to be located in the equipment room of the basement. There are six 320-ton units. The six 1280-g.p.m. chilled water pumps take water from a metered header drawing from an open tank, 11 x 22 x 12 ft., and discharge to a pump discharge header, through the coolers to a cooler discharge header and to the various dehumidifiers. Water returns to the tank by gravity. The basement dehumidifiers return their water to the return tank by means of return pumps.

Water for condensing purposes is cooled by means of air washers located in the penthouse. From the air washers the water flows by gravity to two open tanks, each 9 x 20 x 11 ft. Six 1625-g.p.m. pumps draw the water from a metered header supplied from the tanks. The pumps discharge to a header, through the condensers to another header. From this header the water is carried to the six air washers in the penthouse by means of six 8-in. pipes.

The equipment to be installed is required, within the specified limits of the refrigerating machines, to be of sufficient capacity and to be suitably controlled to produce and maintain the following conditions:

In seasons requiring cooling or dehumidifying, to maintain a dry bulb temperature not to exceed 80° when the outside conditions do not exceed 95° dry bulb and 78° wet bulb and to maintain 50% relative humidity at all times regardless of outside temperature up to 78° wet bulb.

In seasons requiring heating, to heat air delivered to the rooms to a minimum temperature of 70° and maintain a relative humidity of not less than 40%.

These required guarantees as to cooling contemplate that the total number of people in the office spaces shall not exceed one per 100 sq. ft., and that venetian blinds will be installed on all windows having sun exposure. The minimum amount of fresh air is set at 33 1/3%, except for the auditorium and cafeteria systems. The auditorium is for 1097 people and uses 40% fresh air minimum. The cafeteria accommodates 1600 people, and calls for 35,000 c.f.m. fresh air. In addition the system must absorb heat produced by steam tables, toasters, urns, and similar equipment. The Art Gallery system is guaranteed for 85° and 50% relative humidity with 33 1/3% minimum fresh air. Guarantees call for all systems operating at once.

(Concluded on page 75)

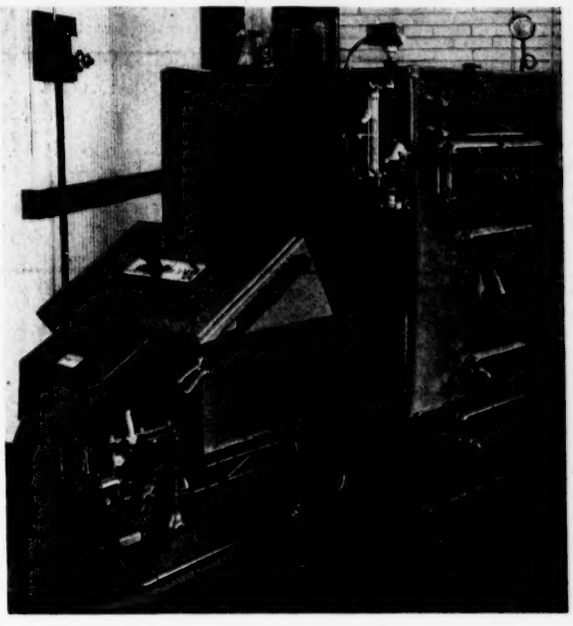
Notes on Underfeed Stoker Operation†

By W. M. PARK‡

THE training of stoker operators too often consists in ordering them to follow the set of rules, without any attempt to teach the fundamentals either of the combustion or mechanical processes which occur in the furnace. Operators thus trained frequently adopt a stoical attitude, viewing their job as a sort of punishment endured in heat and grime, or lack the initiative which might lighten their tasks and eventually lead them to employment in more congenial surroundings.

Stoker Operator Should be Trained

If the early training of stoker operators is supplemented by plain, interesting, non-technical discussions of the purely mechanical details and principles of the stokers he will usually manifest later a desire to acquire knowledge of the combustion process. The service engineers representing equipment manufacturers can be very helpful in this respect when they are making final adjustments, putting new equipment in service and instructing the operators. All too frequent the purchasers try to save money by installing and putting in service expensive stoker equipment without supervision from the manufacturer in a belief that there is something inherent in the device that will save fuel. Unfortunately, a combustion process can be varied in efficiency from over ninety per cent to almost zero by varying the proportions of air and fuel supply. This spread is possible with any type of equipment manufactured. The maximum combustion efficiency is attained by adjusting the various mechanical details which control the coal and air and is sustained by varying the supply of these two commodities both in relation to one another and in relation to the steam demand from the boilers served.



Side installation of a single-retort stoker in a sectional cast iron boiler

Fuels

Single retort underfeed stokers successfully burn coking and non-coking coals, bituminous, semi-bituminous and lignites containing as high as thirty per cent moisture. Coking coals tend to burn more unevenly than non-coking in that they form "cracked" or relatively porous fuel beds.

The size of the particles of coal in the fuel bed is an important factor in establishing both the maximum combustion rate and maximum efficiency of the furnace. The primary stages of combustion will be discussed briefly to indicate the reason for proper coal sizing. Coal emerging from a stoker retort burns most intensely at the top surface of the bed as it is subjected to radiant heat from the flame and furnace walls which cannot readily penetrate below the surface. By conduction, the particles immediately below the surface are heated to the temperature at which their volatile content distills into gas. If the amount of air in the immediate vicinity of these particles is of the proper proportions relative to the amount of gas, ignition will occur as the hydro-carbon and carbon monoxide unite with the oxygen of the air. This in turn ignites the fixed carbon and the process is repeated in the same manner passing downward from particle to particle and layer to layer until the bottom of the fuel bed is reached. A rapid rate of this downward propagation is important as it is the primary concept of a high combustion rate.

Fuel Size is Important

If the coal particles are lumps say of 1 in. size or larger the voids between them are also relatively large and the air too easily passes to the upper layers of the fuel bed. This keeps the sub-surface and bottom layers relatively cold and delays the downward travel of the ignition. Naturally this means a reduced combustion rate over the grate as a whole and limits the capacity as compared with a furnace where the propagation of ignition is rapid. The efficiency of combustion in the fuel bed also is reduced if the coal is too coarse. The reasons are readily seen by comparing a fuel bed with the burner of a modern gas range. The range burner emits a mixture of gas and air from a number of small openings. The resulting combustion liberates more heat without smoke and consequently far less losses than would be possible if the same amount of gas is emitted through a single large open-

†Abstracted by permission from "National Engineer."
‡District Engineer, Combustion Engineering Company, Inc.

ing. Considering each particle of coal in the fuel bed as a source of gas distillation, it will be seen that a fuel bed composed of small size particles will furnish smaller jets of gas. The smaller voids in the bed create thinner layers of air which will more readily mix and burn with the gas. Theoretically, this leads to the conclusion that all particles should be of a small size. From a practical standpoint too great a percentage of fine sizes leads to high stack losses of unburned carbon and dust nuisance from fly ash.

Typical Stoker Fuels

Of the bituminous and semi-bituminous coals burned in the eastern section of the United States, the preferred sizes for domestic stokers are obtained by screening out the fines, or particles, passing through ⅜ in. screen and burning the larger sizes passing over ⅜ in. The maxmium size of pieces should be 1½ in.

In the mid-western field most of the coal operators prepare for domestic stokers a fuel known as "stoker coal" which contains particles from 5/16 to 1¼ in. size. For users who want further refinement in size there are available Chestnut coal of ¾ to 1¼ in. and Pea coal having particles from 5/16 to ¾ in. size. There are available sizes less than 5/16 in., but the use is quite limited on account of the difficulty in passing air through such fine material, the losses due to carbon in fly ash and the rapid accumulation of siftings in the stoker windboxes.

For use with large stokers the midwestern coals are supplied as 1¼ in. or 1½ in. screenings. For single-retort stokers these screenings should contain about fifty per cent fines ½ in. and less in size. In unloading and handling this coal care should be taken to maintain as far as possible a uniformity in size and the mixtures of fines with coarse coal until it is in the stoker hopper. The coarse sizes tend to separate during shipment or in rolling down the slope of storage bunkers, so in many plants the operator is usually confronted with excess air losses and ignition troubles from coarse coal or low capacity, smoke and fly ash from fine slack coal. Spouts should never be run from a bunker set at the side or off center line of the boiler. Coal passing down such spouts segregates in such a way that the coarse coal will be fed to one side of the stoker and all the fines on the other side.

Moisture Aids Combustion

In the midwestern field it is the general practice to temper the coals by addition of three to five per cent moisture within a few hours prior to the time they are burned. This moisture tends to disintegrate the coarser particles so the air supply can reach, more readily, the material on the inside of the particles and the gases distilled therefrom. This effects a noticeable improvement in the quality of the ashpit refuse, and slightly improves the CO_2. The latter improvement is doubtless due to the more intimate mixture of the gas and air in a fuel bed where the particles are small.

Moisture can best be added several hours before burning so it will penetrate the particles of coal. If this is impractical due to the rusting of the metal coal bunkers and spouts or the clogging of coal in the bunkers then it is possible to introduce low pressure steam directly into the mass of coal in the stoker hopper or preferably in spouts leading thereto.

Inspection Service Important

Few machines are subjected to conditions as severe as those which surround a mechanical stoker. Its proximity to a region of high temperature and its intimate contact with abrasive coal and ash makes difficult the general problem of lubrication or makes necessary the operation of certain parts without lubrication. A routine system of inspection and exercise of good judgment in making replacements will minimize outage, insure reliability, and establish physical conditions essential for efficient operation with low maintenance cost. The following recommendations are pertinent to the individual who is responsible for routine inspection of stokers if his work is to be of any real benefit.

Stoker details and the functions of each should be carefully studied so the inspector will know how each part looks when in good repair, the effect that deterioration of one part has on another part and the general effect on capacity and efficiency. The inspector should clearly understand how the fuel is introduced into the furnace, how it is distributed, how it looks when properly distributed and how to correct the distribution if improperly performed.

Air Distribution Important

It is of equal or greater importance to understand the air distributing system as some stokers have provision for both primary and secondary air. Secondary air is that which is supplied above the fuel bed and rarely exceeds fifteen per cent of the total demand for efficient combustion. The location, size and condition of the secondary supply ducts and controlling dampers should be thoroughly understood and there should be a visible means of ascertaining the damper position during operation.

On account of its larger volume and possible effect on efficiency the primary air supply should be most carefully studied. This air enters into the first stages of combustion immediately above the grate so it is of prime importance that the grate or fuel support be in such condition that the primary air is constrained to pass through the fuel bed instead of short-circuiting around the bed. In other words, the grates must properly contact the windboxes and broken or excessively burned bars should be replaced. The control of main windbox air supply should be positive and easy of adjustment. The static pressure of the air supply is a valuable indication to an attentive operator and any gages for its measurement should be properly installed to avoid misleading velocity effects and the zero or "off" point of draft gages should be checked as a maintenance item.

EDITORIALS

Modernizing Institutional Plants

In this issue is the fifth and final of a series of articles in which Carl J. Eckhardt, Jr., has graphically described the evolution of a modern steam generating, distributing and utilizing plant for one of the fast-growing educational institutions of the country. Although the number of buildings served has increased and the use of steam and electrical energy per student nearly doubled, unit costs have been cut astonishingly during the past seven years. These results have been brought about by no magic, but rather by giving sensible consideration to problems as they arose. Then there was an evident willingness to make use of whatever was available to better conditions. Also, parenthetically, there seems to have been enough money on hand to permit doing a good job. In this respect the institution is perhaps not comparable to many others.

At any rate the job has been done and there are at least two interesting points in it for everyone who has connection with similar work.

One is that the results were brought about by contributions of saving all along the line. There were improvements in generation, in plant operation, better distribution lines, and an intelligent use of instruments and controls, each of which contributed its part. The lesson is obvious. Savings are possible by applying new and improved equipment to almost any part of an old or poorly operated institutional plant.

The other point for attention is that there are literally hundreds of plants now operating where essentially similar savings can be made. They are to be found not only in institutions, but in industrial and commercial buildings everywhere. Virtually every such plant ten years or older contains almost none of the newly developed equipment and ideas which made possible the savings at Texas. Everyone knows that these conditions exist and we at least know of the economies possible. The question is, do those in responsible charge know of the magnitude of what they can save for their properties by modernizing their existing plants?

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Summer Cooling Need Not be Expensive

Third season operating results from the cooled residence at Birmingham, Mich., equipped by Detroit Edison for test purposes, are now available. They permit comparisons to be drawn between the results and the costs of using ice or electric refrigeration. Ice shows up rather badly in the comparison.

To some this may be the point of most interest. To most people, however, the really interesting information is that a two-ton refrigerating machine supplying cooling to an eight-room house of 19,000 cu. ft. would operate through a summer as severe as that of 1934 at Detroit at a cost of only slightly more than $19.

The house was well constructed and insulated to be sure, and also Detroit summers are not comparable in severity to those found in many other localities. Even if we make all due allowances, however, it seems apparent that there are many houses in the north where operating costs for the summer season need not exceed $50. There are also thousands of families well able to afford such an expenditure. There is need for many more authentic figures to prove that operating costs are moderate and that residential air conditioning does not have to be an expensive luxury.

PWA Housing Prospects Fade

Prospects of activity in the housing projects for which government money has been set aside by PWA were dimmed by the recent decision upholding the contention that the government cannot condemn private land for such projects. There are assurances that the idea of such projects is not dead, that appeals will be taken, and that local bodies will be set up to do the condemning. These statements are really social or political in character and have nothing to do with the immediate job at hand. Even if the legal difficulties are all finally adjusted and if public sentiment finally supports the idea of publicly financed housing, it is perfectly evident that no large amount of construction can possib'y come from this source soon enough to affect construction totals appreciably for a long time. PWA housing is thus relegated to a position of rapidly decreasing importance so far as any immediate large construction is concerned. In the meantime apartment house construction by private investors continues to be one of the bright spots in the present rise of activity in building. Unless we are interested only in social problems it is certainly more to the point now to place our hopes for immediate business on the privately built apartment house than on the hope that slums may be torn down some time in the future.

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Calculations for Summer Cooling

At the last ASHVE meeting three comparatively young engineers, Faust, Levine, and Urban, outlined a method for computing the summer cooling load. Their proposal was reduced to practice with a computation form and examples. It is thus available for actual use by anyone who wishes to do so.

In brief the method of calculation outlined departs most notably from the methods usually used in that it attempts to take into account the phase relations of the amounts of heat flowing. These amounts are computed at various times and are added in proper phase relation. The resulting greatest sum determines the peak quantity.

We do not know how nearly this method comes to truly estimating the peak. Neither do we know whether in practice it really involves more or less work than do the older methods. It does seem to us though that the proposed method has the logic all in its favor. There can be no doubt at all, it seems to us, that the phase relationship is one which certainly is present not only during the summer but during the winter as well. To use a method of calculation which takes no account of it simply reflects how far our commonly practiced methods depart from really considering the fundamentals of heat flow. About all that can be said in favor of the older method is that it served a useful purpose so long as there was no better proposal. At the time it was developed by Rietschel and his co-workers it was a remarkable piece of systematization of what had previously been scattered information supplemented by rules of thumb. To us it seems that the same comment can be made about the method proposed by Faust, et al. It also attempts to systematize what had hitherto been scattered data. We believe that it is a move to be commended in spirit and encouraged in every way. Missing data should be developed as fast as possible and experiences with this method should be reported as fast as there are conclusions.

It is also significant and commendable that this first important departure from accepted methods of computation should be proposed by young engineers.

ABSTRACTS of Current Papers, Books and Pamphlets

The Market for Heating and Fuels in Austin, Texas

Ownership of an automobile and a home equipped with electricity were reported in 1934 by more families in Austin, Tex., whose annual incomes for the preceding year were less than $1,000 than by consumers within any one of the six higher income classes, according to a recently completed Department of Commerce study on "Consumer Use of Selected Goods and Services by Income Classes."

This compilation constitutes the first correlation of this kind showing the relationship between income and consumption. The new material is of national interest since the manufacturers of the products included in the study are located in various sections of the country. The report provides factual data designed to be of practical value to manufacturers, wholesalers and retailers of the specified commodities whose sales territory include this city or similar communities.

The commodities covered in the study include house-heating apparatus; materials used in home construction; fuel for heating and cooking; lighting facilities; plumbing installations; mechanical refrigerators, and automobiles. The facts given pertain also to innumerable related products.

The 16 tables—showing a classification of families by income groups together with the percentage distribution of goods and services among these groups—reveal, for instance, that the income class comprised of consumers receiving between $5,000 and $7,000 has the highest percentage of families living in single-family dwellings; using mechanical refrigeration, and owning more than one car per family.

The department has announced similar studies for future publication covering Fargo, N. D., Portland, Me., Columbia, S. C., and Salt Lake City Utah.

[*"Consumer Use of Selected Goods and Services, by Income Classes, Austin, Texas"; Market Research Series No. 5.1, by Ada Lillian Bush, chief of the consumer market section of the marketing research and service division, Department of Commerce. Standard size; stiff paper bound; 18 pages of text and 16 tables; multigraphed. Obtainable from the Department of Commerce, Washington, or branch offices; price, 10 cents.*]

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Psychrometric Notes and Tables

The author of this book has done an excellent job in both gathering together a large amount of psychrometric information which up to now has been available only from various scattered sources, and in presenting the data in such a manner as to make the book a guide for solving psychrometric problems.

The contents of the book are divided into four main parts. The first is made up of definitions in the form of questions and answers of the various technical terms met with in this work. The second part contains six tables of psychrometric data—one of relative humidity as determined by the dry and wet bulb temperatures; one of the dewpoints from relative humidities and dry bulb temperatures; another of the dewpoints from dry and wet bulb temperatures; one of vapor pressures from dry and wet bulb temperatures; one of absolute humidities from relative humidities and dry bulb temperatures, and one of mixtures of air and saturated water vapors.

The third part is composed of a number of examples which illustrate the method of solution of practically every type of psychrometric problem that may be solved with the aid of these tables. The last part is made up of a large amount of miscellaneous data most frequently connected with this type of work.

[*"Psychrometric Notes and Tables," by Elmer Torok. Published by the North American Rayon Corp., 261 5th Ave., New York. Flexible binding; 5 x 7 in.; 89 pages; price, $2.*]

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Statistical Data on Coal

The accompanying table, showing the amounts of fuels used for domestic purposes in the United States, is from the pamphlet "Coal," a statistical appendix to the Minerals Yearbook for 1934. The booklet, which is published yearly,

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown to indicate the trend of growth]

	1924	1930	1931	1932	1933
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56, 576, 296	42, 508, 088	35, 437, 946	29, 096, 962	27, 755, 331
Shipments of buckwheat No. 1 [1]	9, 510, 508	8, 570, 032	7, 956, 978	6, 735, 313	6, 625, 755
Shipments of smaller steam sizes	11, 160, 695	10, 123, 937	9, 240, 931	8, 029, 388	8, 954, 321
Local sales	3, 043, 939	3, 144, 434	2, 901, 117	2, 810, 337	3, 249, 552
Total commercial production	80, 291, 438	64, 346, 491	55, 536, 972	46, 672, 000	46, 584, 961
Anthracite exported	4, 017, 785	2, 551, 659	1, 778, 308	1, 303, 355	1, 004, 562
Anthracite imported, chiefly from United Kingdom and Russia	117, 951	674, 812	637, 951	607,097	456, 252
Fuel briquets produced	580, 470	1, 028, 865	698, 316	470, 604	530, 430
Fuel briquets imported	38	73, 418	60, 950	80, 298	42, 305
Byproduct coke sold for domestic use	2, 812, 771	7, 886, 432	8, 376, 652	9, 422, 343	10, 215, 300
Beehive coke sold for domestic use	139, 886	141, 391	118, 665	207, 857	275, 677
Coke imported	82, 833	132, 674	103, 563	117, 275	160, 873
Gas-house coke sold	[2] 1, 400, 000	[2] 1, 300, 000	1, 273, 000	[2] 1, 250, 000	498, 000
Petroleum coke produced [3]	761, 100	1, 940, 000	2, 032, 000	1, 789, 000	1, 576, 000
Anthracite and semianthracite produced outside of Pennsylvania	704, 513	708, 221	507, 140	454, 028	350, 068
Bituminous coal for domestic use	(4)	(4)	(4)	(4)	(4)
Oil (barrels) [5]					
Domestic heating oils: [6]					
Range oil	(7)	(7)	4, 549, 000	6, 841, 000	9, 849, 000
Other light fuel oils	[2] 5, 021, 000	25, 771, 000	[2] 24, 848, 000	29, 264, 000	34, 140, 000
Commercial heating oils [8]	(7)	17, 508, 000	15, 731, 000	(7)	(7)
Gas (million cubic feet)					
Natural gas consumed for domestic use [10]	285, 152	376, 407	380, 897	385, 887	388, 774
Manufactured gas sold for domestic and house heating purposes	(7)	(7)	[11] 275, 318	(7)	[11] 226, 857

[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] How much petroleum coke was used for house fuel prior to 1928 is not known. For that year 235,000 tons were reported to have been consumed for domestic heating, according to E. B. Swanson in Economic Paper 9, Bureau of Mines.
[4] Between 56,000,000 and 77,000,000 tons a year.
[5] Based on surveys made by the Petroleum Economics Division, Bureau of Mines.
[6] Oil used for heating houses.
[7] Data not available.
[8] Revised.
[9] Oil used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses.
[10] Includes heating of apartments and commercial buildings.
[11] From Census of Manufactures.

contains detailed statistics on the production, distribution, and consumption of coal and some related products.

[*"Coal," by W. H. Young, L. Mann, H. L. Bennit, and F. G. Tryon; published by the Department of Interior, Bureau of Mines, Washington. Size, 6 x 9 in., paper-bound, 80 pages. Obtainable from the Superintendent of Documents, Washington; price, 10 cents.*]

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Dust and Silicosis

There has been a large amount of literature issued by various sources on dusts and silicosis but up to the present time there has been no comprehensive review of the subject. It is the purpose of the Bureau of Mines to publish three circulars dealing with dusts and dust diseases in industry.

Two of the three booklets have now been published. The first is made up of a comprehensive review of available literature on the effects of breathing dusts, with special reference to silicosis. The second deals with silicosis and covers the prevention of dust diseases, principal dust factors producing pulmonary pathology, determination of dust

(Concluded on page 75)

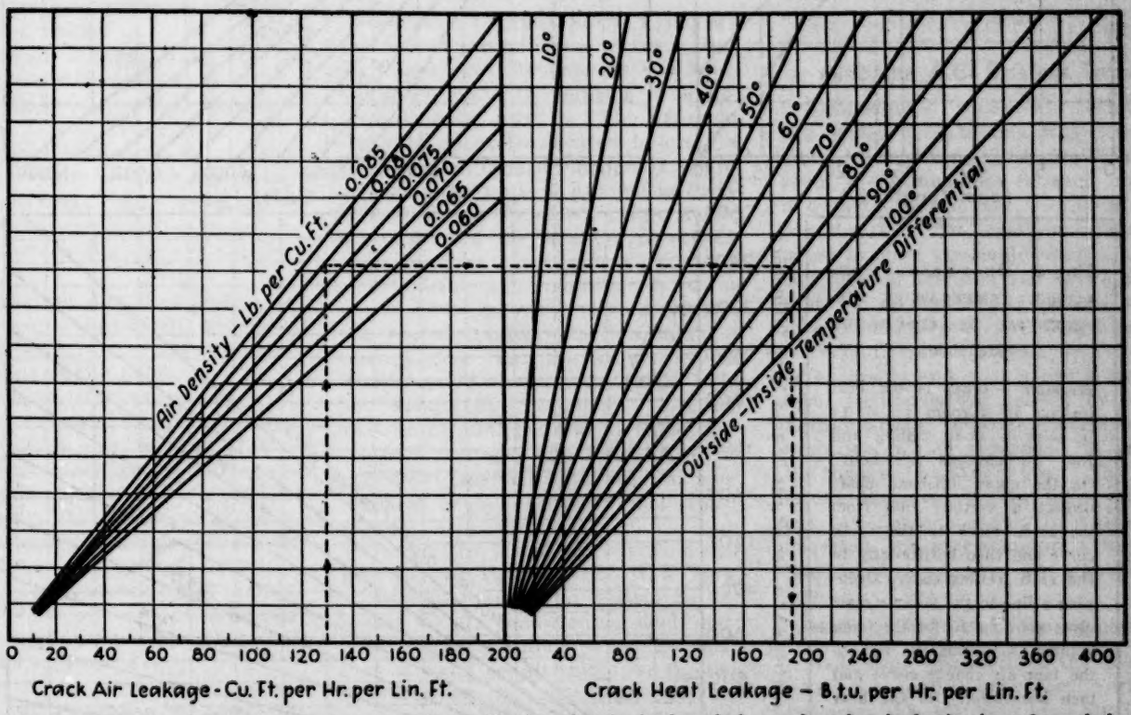
ESTIMATING HEAT FROM FILTRATION AIR

TABLE 1

VALUES OF LEAKAGE FACTOR (L IN EQUATION 2C)
AND B.T.U. PER HR. PER FT. OF EXPOSED WINDOW CRACK

(Temperature difference of 70° for use in estimating winter Loads)

1	2	3	4	5	6	7	8
Method of Support	Sash Material	Wind Protection	Construction Features	Fit or Condition	Perimeter (P) in Ft.	Leakage (L) Cu. Ft. per Hr. 15 M P.H.	L x 1.25 B.t.u. per Ft.
Double Hung or Casement	Wood	None	Usual run of Millwork and Hand-Work on site	Average Tightness (Unlocked)	For Double Hung three times the Width of Sash plus twice Height of Window. For Casement total Length of crack	40	50
	Wood	Weather Stripping				24	30
	Wood	None		Poorly Fitted (Unlocked)		110	140
	Wood	Weather Stripping				34	43
Double Hung	Metal	None		Unlocked		75	95
	Metal	Weather Stripping				31.5	40
Rolled Section Steel Sash							
Industrial Type { *With Ventilator horizontally pivoted, lower part swinging out*					Use perimeter of Swinging Section only	175	220
School & Public Bldg. { *Sections heavier than above, Ventilators balanced on side arms.*						90	113
Residential Casement						50	63
Heavy Section Casement						40	50



Example—If the crack air leakage is 130 cu. ft. per lin. ft., what is the heat leakage when the air density is 0.080 and the temperature differential 80°? Project a vertical line from the 130 cu. ft. mark on the left-hand chart up to the 0.080 air density line. Then a horizontal line to the 80° temperature differential curve and a vertical line to the heat leakage scale. The leakage is found to be 193 B.t.u. per hr. per lin. ft.

Fig. 1. Chart for determining heat leakage for various air densities and temperature differentials.

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ESTIMATING HEAT FROM FILTRATION AIR

TABLE 2. FILTRATION OF AIR

Air changes (n in equation 2b) and heat changes in B.t.u. per hr. at 70° temperature difference

Room or Building Type	No. of Sides or Room on Building Having Windows	1 Number of Air Changes per Hr. (n)	2 n × 1.36 B.t.u. per Hr. per Cu. Ft. or Room Vol. at 70° Dif.
1. Office buildings; apartment houses; hotels; dormitories; multistory buildings in general	none	½	0.62
	one or two	¾ to 1½	0.94 to 1.89
	three or four	2	2.52
2. Entrance halls or vestibules	any	2	2.72
3. Industrial or factory buildings	any	2-3	2.52-3.78
4. Single, double, or duplex residences (all rooms)	any	1-1½	1.26-1.89
5. Public or monumental buildings	any	1½-2	1.89-2.72

Well installed weatherstripping may be credited with reducing air and heat quantity by 40 to 60% for purposes of winter estimating.

There are two methods of estimating the amount of filtration heat—(a) the window-leakage and (b) the air-change method.

Calculations by the window-leakage method make use of leakage factors (L) which have been found by experiment and tabulated in Table 1. The table lists the amount of air leakage in cu. ft. per hr. per lin. ft. of crack for winter conditions.* Thus, to determine the filtration heat (F) by this method, the perimeter of the window (P) is measured as shown in table. These figures are then substituted in the formula

$$F = L \times P \times 0.24d\ (t_1 - t_o) \qquad (2c)$$

where d is the density of air, usually taken as 0.075, t_1 is the temperature of the indoor air, and t_o is the temperature of the outdoor air.

In determining the number of windows to use, the following rules are suggested. Where the room has windows on one side only, use them all in arriving at the window perimeter. Where the room has windows on two sides, consider only the side having the greater crack length. In no case, even if the room or building is exposed on all sides, use less than half the total crack. Fig. 1 may be used for solving problems involving other than standard air densities and temperature differentials.

In the air change method the volume of the room v is first determined by measurement. The air-change factor is then obtained from Table 2. The filtration heat is then

$$F = n \times v \times 0.24d\ (t_1 - t_o) \qquad (2b)$$

with d, t_1, t_o the same as in formula (2c).

Fig. 2 furnishes a graphical method of finding the heat from filtration air by the air change method. When this method is employed it is unnecessary to use formula (2b).

*Heat from filtration air is usually neglected in making summer cooling calculations.

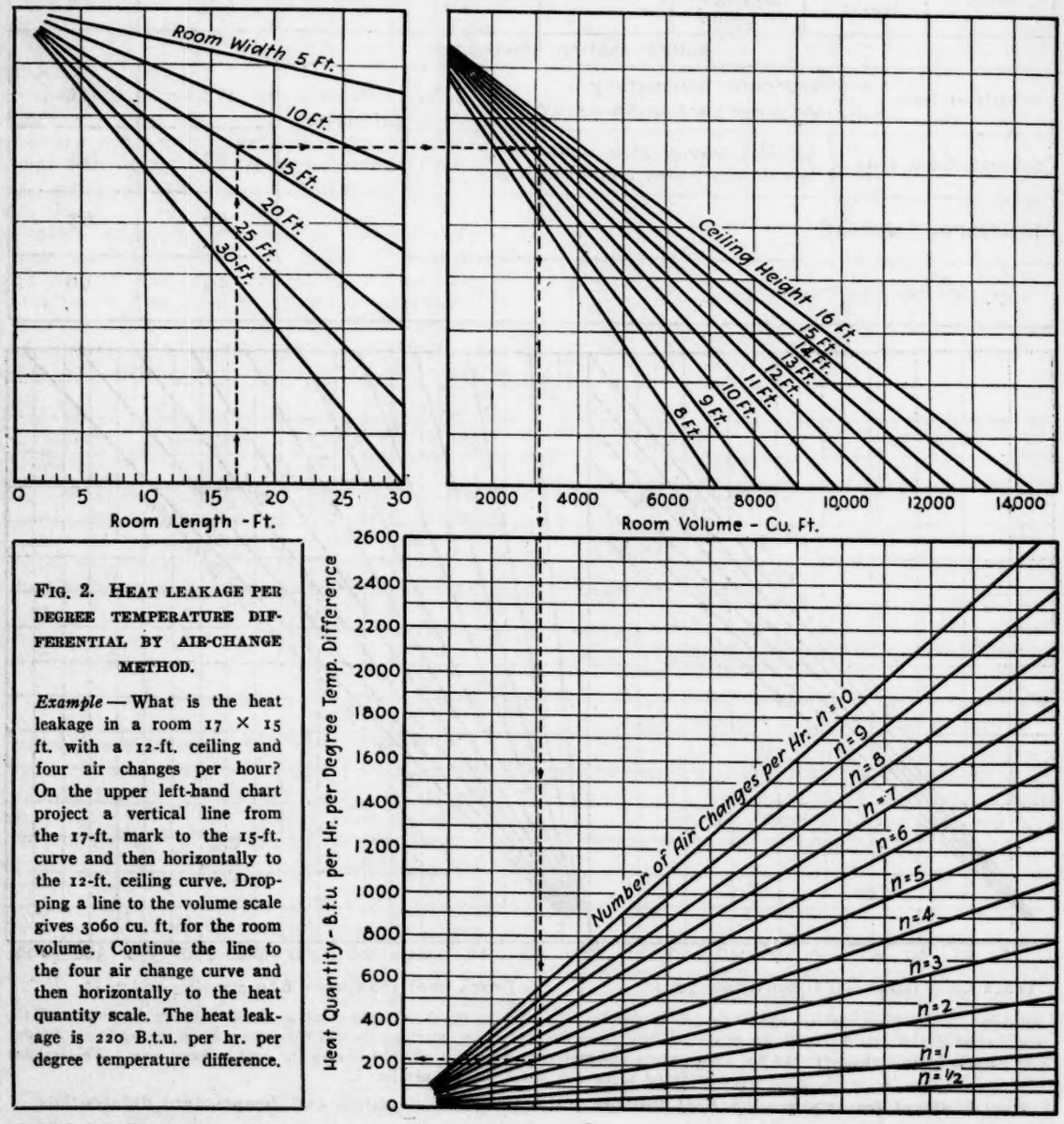

FIG. 2. HEAT LEAKAGE PER DEGREE TEMPERATURE DIFFERENTIAL BY AIR-CHANGE METHOD.

Example — What is the heat leakage in a room 17 × 15 ft. with a 12-ft. ceiling and four air changes per hour? On the upper left-hand chart project a vertical line from the 17-ft. mark to the 15-ft. curve and then horizontally to the 12-ft. ceiling curve. Dropping a line to the volume scale gives 3060 cu. ft. for the room volume. Continue the line to the four air change curve and then horizontally to the heat quantity scale. The heat leakage is 220 B.t.u. per hr. per degree temperature difference.

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NEWS OF THE MONTH

Oil Burner Institute Succeeds AOBA

CLEVELAND.—At a two-day meeting held here on July 9-10, attended by a large number of manufacturers in the oil burner industry and presided over by W. J. Smith, president of the AOBA, the creation of Oil Burner Institute to succeed the American Oil Burner Association and the adoption of a broad gauge program were unanimously voted.

The new program contemplates a broadened membership to include all manufacturers of oil burning appliances in the United States and the inauguration of detailed plans which will exert a stimulating influence of far reaching benefits to oil producers and refiners as well as to the oil burning appliance manufacturers themselves. Present members of AOBA will automatically become members of the new Oil Burner Institute.

The following were named as the immediate objectives of the new organization:

1.—Formation of a strong solidified organization to carry out the mutual objectives of all oil burning appliance manufacturers and affiliated interests in the United States.

2.—Promotion of high standards of equipment, establishment of an O.B.I. symbol of approval, and its national exploitation.

3.—National vigilance to oppose passage of unfair and unreasonable laws, ordinances and regulations through cooperation with the membership in various sections of the country affected.

4.—Compilation and distribution of essential trade information and data for advancement of the industry and enlightenment of the public.

5.—Promotion of free exchange of information between members looking toward increased economy and profits.

6.—An aggressive program for advancement, including an annual exhibit or show, to assure a growing recognition among manufacturers of progress to be made through solidarity of planned cooperation and action with each other and with each of the component elements of the allied industries and services.

President Smith announced the selection by the executive committee of G. Harvey Porter, Baltimore, as managing director of the new Institute. Mr. Porter has been for many years and will remain as the operating vice-president of The Industrial Corp., Baltimore, a financing and managing organization. In addition to these duties, however, he will personally direct the work of the Institute.

At the conclusion of the Cleveland meeting Mr. Smith made the following statement:

"The program we have unanimously adopted at this meeting is undoubtedly the most far reaching step ever taken by our industry. I know that we are all solidly behind this program and in complete sympathy and accord with the broad gauge objectives we have undertaken. They will be of untold benefit to us all."

Consulting Firm to Reorganize

PHILADELPHIA—L. E. Moody and J. E. Hutchison, formerly associated with the late Isaac Hathaway Francis, have formed an association under the firm name of Moody & Hutchison to continue practicing consulting engineering along the lines of the complete mechanical and electrical equipment of buildings, including heating, ventilating and air conditioning. Their offices will be located at 1520 Locust Street until September 1 when they will be moved to the Architects' Building, 17 and Sansom Streets.

Automatic Products Buys A. C. Concern

CHICAGO — Chicago Stock Exchange approval of the purchase of the Aeriet Air Conditioner Company by The Automatic Products Corporation was announced here July 15. The approval and subsequent transaction followed a letter written by Vincent Bendix, chairman of the board of Automatic Products, outlining the merits of the Aeriet Company and its business potentia'ities.

"Following a thorough survey of the air conditioning field in general and the Aeriet Company in particular, it was obvious that the acquisition of this company was very desirable," said Mr. Bendix in his letter. "We are anxious to participate in air conditioning, both domestic and industrial, in an aggressive manner and we are now prepared to go ahead with such a program.

"In the first place our controlled subsidiary, The Permutit Co., New York, is especially suited to engage in the industrial air conditioning field. Air conditioning parallels with the business of water conditioning and the two activities can be consolidated in the same engineering, manufacturing, and sales departments.

"Then the Aeriet Company had the excellent sponsorship of the Air-Way Electric Appliance Corp., Toledo, for several years and for the past five years has been directed by Walter L. Mack, president and general manager, and a man thoroughly experienced in the air conditioning field."

A. C. Bureau Formed

SPRINGFIELD, MASS.—The Air Conditioning Bureau of Springfield has been organized here with headquarters at 65 State Street. The officers are as follows: Frank Wyckoff, president; Lawrence Davis, vice-president; Albert Bailey, treasurer; and Thomas Lawless, secretary. The directors are Milton Bearg, Richard Harper, and H. W. Lawrence.

The association was formed with the idea of further acquainting the general public with the advantages of air conditioning. The members of the association, who only handle air conditioning equipment, believed that the public would be better informed and educated in air conditioning if it was presented to them in a uniform manner. The members organized to conduct cooperative advertising, publicity and sales promotion campaigns.

The United Electric Light Corp., Springfield, is used as a clearing house for the association. This concern encloses circulars and advertising matter describing air conditioning advantages with its monthly bills. In addition large newspaper space is being utilized. At the present time 12 air conditioning firms are members.

Alabama A.C. Dealers Taxed

BIRMINGHAM, ALA.—Air conditioning dealers in Alabama will hereafter pay a state tax of $100 a year, enabling them to do business in each county, and furthermore they will be glad to pay the tax. The legislature first proposed to treat air conditioning like the contracting business and levy 1% for each job up to $100,000 and 2% on all jobs over $100,000. The Birmingham Air Conditioning Bureau held this to be excessive and sent a committee before the legislature headed by James Arthur Smith, General Electric representative, which succeeded in getting the tax fixed at $100 a year. The legislature then wanted to make dealers pay $100 in each county in which they operated, but later abandoned this idea, making the tax cover the whole state.

Metropolitan A.C. Reorganized

NEW YORK—Henceforth the Westinghouse air conditioning New York distributor, the Metropolitan Air Conditioning Corporation, will be known as the Metropolitan Air Conditioning Company, reorganization having occurred. Officers will remain the same, however, these being T. J., Martin, and Michael Charles, brothers. The revised organization will continue to handle air conditioning work of practical'y any size and character.

75 A.C. Homes for Washington

WASHINGTON—The trend to air conditioning which has been so heavily established in this city, largely through the example and activities of the United States Government, is now extending to home construction in the Capital. The latest development is a building program inaugurated by a Washington builder, in which at least 75 houses will be air conditioned.

Included in this group will be all homes in Rollingwood, a 15-house development with a price range from $15,000 to $20,000; all homes in Rock Creek Terrace, 22-house project with a range from $20,000 to $30,000, and at least 38 houses in a third project of 100 homes, ranging from $13,000 to $15,000.

Specially designed air conditioning systems will be used exclusively in the 75 houses, which will have as standard equipment year 'round air conditioning systems, with the exception of the compressor used to supply refrigeration for summer cooling and dehumidifying. Thus winter air conditioning is assured, and the buyer of the house may easily add summer conditioning whenever he pleases, merely by buying a compressor. All other equipment necessary for summer conditioning is included in the special central system.

Operated for winter use, the system to be used in each house will heat, humidify, clean, and circulate the air. Each will be equipped with an oil burning boiler and a special air conditioning central system unit suspended from the basement ceiling and containing humidifier, filters, heating coils, cooling and dehumidifying coils, and a blower. The conditioned air will be carried to the rooms by concealed ducts and discharged into them through attractive grilles which will diffuse the air evenly and effectively.

The addition of a compressor for summer use will furnish approximately 1000 c.f.m. of conditioned air, including 300 of outside air, in each house. This will provide 24,000 B.t..u. per hr. of cooling (equivalent to the use of two tons of ice in 24 hr.) with a temperature of as much as 15° lower than that outside, the maximum difference advisable for comfort and health. In winter it will supply 90,000 B.t.u. per hr. of heat. The air for each room will be completely changed six times per hour in the heating season, eight or nine times per hour when used for cooling. As the 75 houses will vary considerably in size and other factors, these figures are approximate and apply to an average house typical of all. All controls for the system will operate automatically.

The installations will be made by the Hudson Air Conditioning Corp., Washington.

A.C. for Hotel Sherman

CHICAGO—The Hotel Sherman has been making strides toward the establishment of ideal air conditioning control throughout the hotel. The latest improvement is the air conditioning of the grand ballroom. This job has recently been completed under the direction of Arthur M. Wilkinson, chief engineer.

A Wittenmeier CO_2 compressor has been installed for cooling. The original air supply fans are used with some changes in the existing ventilating ductwork, particularly for recirculation. Likewise the air washers with the addition of cooling coils make air conditioning possible.

The system will take care of a dancing and dining capacity of 1,000, or 2,000 in meeting session. Since the grand ballroom is used only on occasions, arrangements have been made in the ductwork to supply conditioned air from the same plant to the several smaller meeting rooms in the building.

General Electric A.C. Offices Moved

NEW YORK—Offices of the air conditioning department of the General Electric Company have been moved from the G-E Building at 570 Lexington Ave., New York, to the Bloomfield Works of the company, 5 Lawrence St., Bloomfield, N. J., it has been announced by J. J. Donovan, manager of the department.

The move included the main sales, advertising, and engineering offices formerly located in the General Electric Building in New York, and design, engineering, and manufacturing activities formerly carried on in Schenectady, Philadelphia, Cleveland, and other eastern cities.

The consolidation of activities at Bloomfield took effect July 15. The move was made in the belief that uniting all operations under one roof would result in the most efficient and economical production and promotion. The development of new equipment, in particular, will be carried on most efficiently in that manner, with research engineers, designers, sales, and advertising staffs at one point to cooperate in all steps concerning such development.

Jersey A.C. Sales Doubled

NEWARK—Air conditioning continues to grow rapidly in favor with customers of the Public Service Gas & Electric Company. Twenty-one electrical refrigerating air conditioning units for summer use were purchased by Public Service customers in the first five months of 1935. This is nearly double the number in the corresponding period last year.

Westinghouse A. C. Transferred

EAST PITTSBURGH—Transfer of the air conditioning department from East Pittsburgh, Pa., to Mansfield, Ohio, where it becomes a part of the Merchandising division, is announced by A. E. Allen, vice-president in charge of the Westinghouse Electric & Manufacturing Company's merchandising operations. This transfer affects all sales, engineering, and manufacturing activities of the air conditioning department.

The purpose of this change, according to the Westinghouse merchandising executive, is to effect a closer coordination, particularly in the design and manufacture of air conditioning equipment, with the other closely allied products now within the scope of the merchandising division.

Announcing the transfer, Mr. Allen stated that the company's air conditioning program will be enlarged and expanded, and predicts that this business will be of great importance to the future activity of the merchandising division. Westinghouse will continue to distribute its air conditioning products through its present dealer channels, he continued.

The engineering and manufacturing of air conditioning products will be centered at the East Springfield, Mass., plant of the Westinghouse Company. The sales headquarters will be located at the Mansfield plant, the headquarters of the merchandising division. S. F. Myers will continue as manager of air conditioning sales in the refrigeration and air conditioning department.

A.C. Display in Chicago

CHICAGO—Because of the rapidly increasing interest in air conditioning in Chicago, the Commonwealth Edison Company has opened a display of cooling equipment in its downtown Electric Shop at 72 West Adams Street.

The company does not sell air conditioning devices, but will maintain this showroom so that Chicagoans can conveniently see and obtain information concerning the various kinds of cooling equipment.

Eight leading manufacturers are represented in the exhibit. The devices displayed are principally of the room cooler type for use in small homes, offices, and shops and all are in actual operation.

A recent compilation by the Commonwealth Edison Company reveals that nearly 150 of its customers have adopted electric air conditioning since the first of this year.

Coke Sales

WASHINGTON—According to the U. S. Bureau of Mines, 10,174,114 tons of byproduct coke, valued at $59,274,945, were sold for domestic use in 1934.

In addition, there were sold for domestic use 346,181 tons of beehive coke valued at $1,163,910.

A.C. Exhibit on Atlantic City Boardwalk

ATLANTIC CITY, N. J.—A series of displays presenting air conditioning as a factor in the average home has been arranged by the Du Pont Exhibit on the Boardwalk here and will be a principal feature during the summer months.

In order to create the atmosphere of the average home, a room 15 x 17 ft. has been built at one end of the Exhibit, a room complete in every respect, with two windows facing on a street, and furnished in living room style. Thermometers, placed outside the entrance to the room and inside the room, give the actual difference in temperatures. All visitors are invited to enter. The staff of the Exhibit explains and demonstrates the working of the apparatus on view. Several types of apparatus will be used in the series of displays, each type being presented exclusively in the room for the period of time devoted to its display. This period of time will be ten days or two weeks. The whole plan of presentation is to give visitors an opportunity of seeing and experiencing air conditioning in a modern home under average conditions. Units manufactured by Frigidaire, Westinghouse, General Electric, Kelvinator, and the Clark Equipment Company are among those now scheduled to take part in the exhibition.

New ASHVE Chapter Planned

WINNIPEG, MAN.—When organization work is completed in the near future, western Canada will have a chapter of the ASHVE, with headquarters in this city. Thomas MacDonald, sales manager, Minneapolis-Honeywell Regulator Co. Ltd., Toronto, and vice-president of the Ontario Chapter, ASHVE, was in Winnipeg recently, and gave advice at an organization meeting of a number of members of the local heating and ventilating field. It is planned to hold regular monthly meetings commencing in September, 1935.

J. B. Steele, mechanical superintendent, Winnipeg Public School Board, is one of the organizers.

Sarco Requests Catalogs

NEW YORK—Sarco Co., Inc., 40 East 34th St., is equipping a new factory for the production of steam traps and temperature control apparatus. T. Napier Adlam, chief engineer, will be glad to receive catalogs.

Thrush Appoints Canadian Agent

MONTREAL, QUE.—H. A. Thrush & Co., Peru, Ind., manufacturer of heating specialties, has appointed Railway & Engineering Specialties Ltd., this city, as Canadian sales agent.

Modine Announces Cash Prize Contest

MODINE, WIS.—With a grand prize of $200 in cash and 26 others ranging from $50 to $10 each, Modine Manufacturing Company has announced the detailed rules governing a competition intended to bring out suitable designs for heating a one-story bus storage and and repair garage 90 ft. x 128 ft. in plan. The awards, to be made in November, are solely on the selection for sound performance and reasonable economy of suitable models of steam heated Modine unit heaters. Location of the units and direction of the air stream are also to be considered, together with the reasons given for the design features as explained in the contestant's own words. The contest is not literary or for producing artistic designs—good, sound working layouts are wanted and consequently literary form, spelling, and neatness are ruled out.

Entry is easy and the competition is open to nearly anyone directly connected with the heating, piping, and air conditioning industry. In order to reduce the amount of work required heat losses are given, as are the steam pressure and electric current characteristics.

Contestants are limited to one entry only, and the solution must be postmarked before midnight of Monday, September 30, 1935. The company hopes that this contest will stimulate interest in the use of unit heaters and at the same time bring out the reasons for selecting and locating these units in a workable fashion.

Gas Heating Bill Guaranteed

BIRMINGHAM, ALA.—A guaranteed gas bill is the inducement being thrown out this year in a campaign by the Birmingham Gas Company for the sale of house-heating appliances. The plan is offered to attract the interest of those who think gas heating too expensive for them. An engineer for the company makes an estimate of the operating cost on any job and the guarantee is then made that the actual cost during the first year will not be more than 10% of the estimate.

On top of this proposition, the company is offering to rent conversion burners for boilers and furnaces for $5 down and $3.50 per month for the seven heating months. For the other five months of the year no rental is assessed. If at any time the customer becomes dissatisfied the company agrees to remove the rental burner and put the furnace or boiler back in the condition it was found. But if the customer wishes to keep the burner, he can then apply the rental payments toward the purchase of the appliance.

Opens Modernizing Office

BOSTON—Joseph Silverman, formerly manager for Arvedon Bros. of their home modernizing division, has established The Boylston Co., 911 Boylston Street, this city, to supply a complete home modernizing and modernizing consultation service, carrying also plumbing, heating plants, Silent Glow burners, and a full line of home appliances with which to serve clients. Affiliated with The Boylston Company's service is a group of heating, ventilating, plumbing, and general building contractors and specialists, to supply any type of modernizing required, fully financed under FHA terms; also a consulting architect and a designer to draw sketches in color, enabling the homeowner to visualize how a piece of modernizing will look when finished.

Chicago A. C. Committee Meets

CHICAGO—The Chicago committee on air conditioning standards at its third meeting took initial steps in drawing up a set of standards for certified air conditioning for Chicago. The committee met in the office of John M. Howatt, chief engineer, for the board of education and chairman of the committee.

Standards for certified air conditioning proposed by the committee include methods of checking the efficiency of air conditioning equipment; outside and inside summer and winter relative temperatures; standard specifications governing infiltration and leakage of air; design allowances for heat gain due to sunlight, and allowance for shading and specifications for air quantities and other refrigeration requirements.

Boston A. C. Bureau Meets

BOSTON—Members of the Air Conditioning Bureau of Boston held their regular monthly dinner and meeting on July 25, with about 75 members and guests attending the dinner at the Hotel Bradford Grill and a hundred or more the meeting at the Edison Auditorium. This was presided over by Julius Daniels, the subject of the discussion being "Water Vapor Refrigeration As Applied to Air Conditioning." The guest speaker who gave this address was F. E. Hibberd, refrigeration engineer, Ingersoll-Rand Co., N. Y.

The August meeting will be held on Thursday the 22nd, and will take the form of an outing.

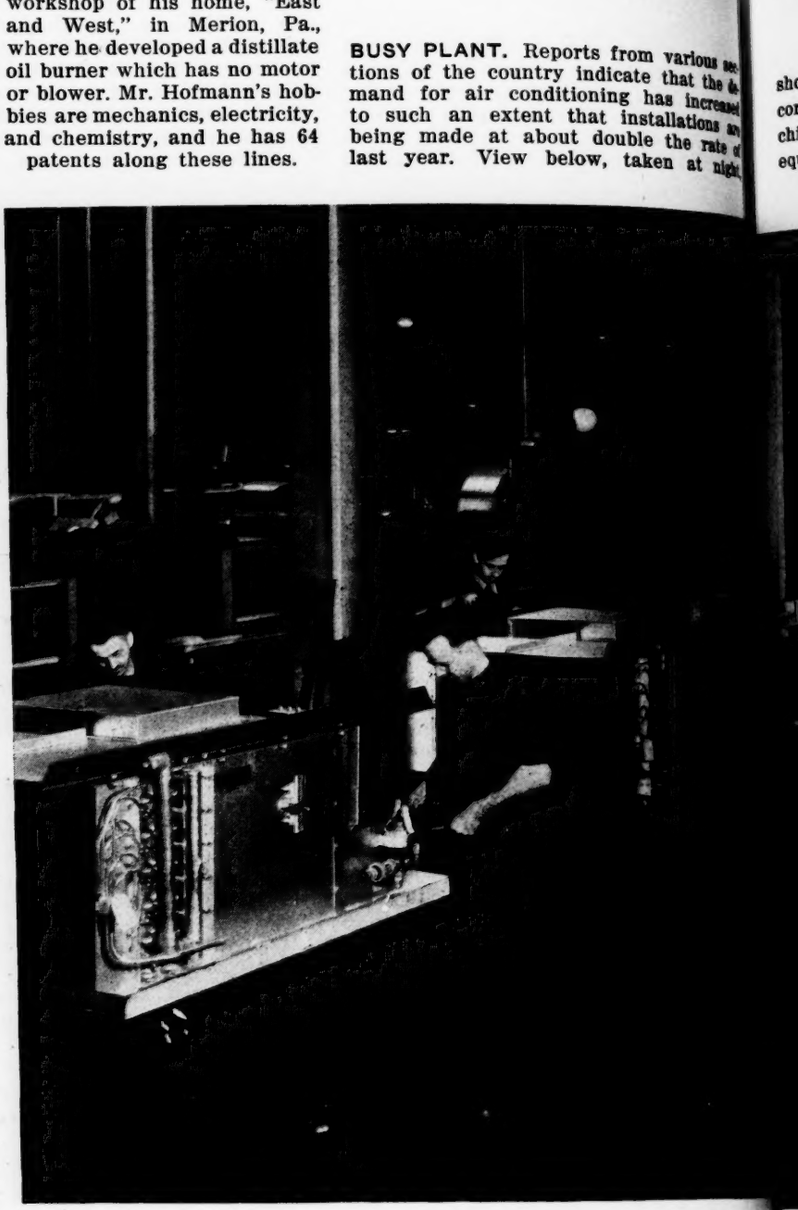
189 Chicago Offices Cooled

CHICAGO—Air conditioning equipment has now been installed in 126 private offices and 63 general offices in Chicago, according to the "Wall Street Journal." This represents an increase of 27 installations in private and general offices between April and July.

PICTURE

PIANIST INVENTS BURNER. Josef Hofmann, internationally known pianist and director of The Curtis Institute of Music, Philadelphia, shown in the workshop of his home, "East and West," in Merion, Pa., where he developed a distillate oil burner which has no motor or blower. Mr. Hofmann's hobbies are mechanics, electricity, and chemistry, and he has 64 patents along these lines.

BUSY PLANT. Reports from various sections of the country indicate that the demand for air conditioning has increased to such an extent that installations are being made at about double the rate of last year. View below, taken at night

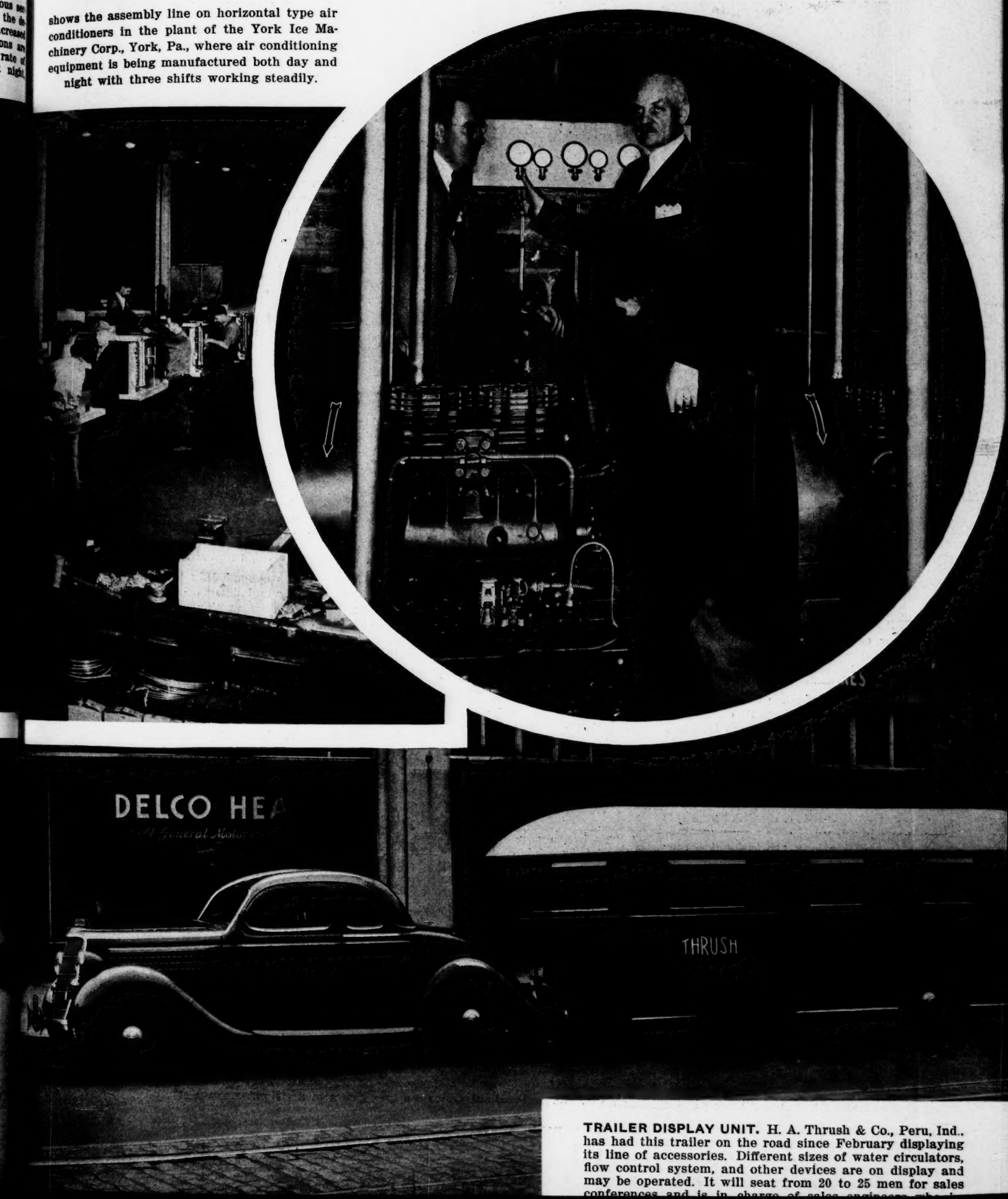


Mr. Hofmann is shown above with his oil burner, which is designed for homes, hotels, and for industrial processes. In addition to the burner, Mr. Hofmann has invented an air spring for motor vehicles, an automatic piano touch for recording of player piano rolls, and other devices.

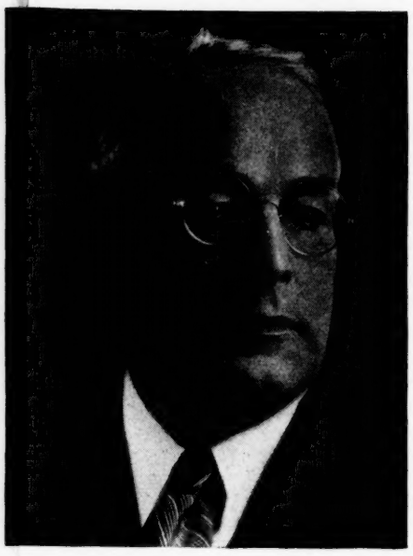
PARAGRAPHS

HOTEL MAYTAG CONDITIONED. F. L. Maytag, right, washing machine king, turns on the 100-ton Frigidaire air conditioning system of the Hotel Maytag, Newton, Iowa, making it one of the few completely air conditioned hotels in the world. E. W. Zeug, president of the Maytag Hotel company, witnesses the operation. This is believed to be the first hotel conditioned in such a small locality, Newton having a population of only 12,000. The lobby is not cooled, to discourage loungers.

shows the assembly line on horizontal type air conditioners in the plant of the York Ice Machinery Corp., York, Pa., where air conditioning equipment is being manufactured both day and night with three shifts working steadily.



TRAILER DISPLAY UNIT. H. A. Thrush & Co., Peru, Ind., has had this trailer on the road since February displaying its line of accessories. Different sizes of water circulators, flow control system, and other devices are on display and may be operated. It will seat from 20 to 25 men for sales conferences and is in charge of sales engineers who



Isaac Hathaway Francis II

PHILADELPHIA—Isaac Hathaway Francis II, consulting engineer of this city, died June 26 at his home, "Westleigh Farms," Devon, Pa., at the age of 57, after a short illness.

Born in Baltimore, June 27, 1877, Mr. Francis was educated in Baltimore City College, at Johns Hopkins University, and received his M.E. degree from Cornell University in 1901.

In 1901 he became associated with Adams and Schwab, consulting engineers of Baltimore, and in 1902 entered private practice in Philadelphia.

In May, 1918, during the World War, Mr. Francis was called to serve as head of the Plant Facilities Section of the Philadelphia District Ordnance Office. After the Armistice he was appointed a member of the Claims Board and later chairman of the District Salvage Board and Commanding Officer for the Philadelphia Ordnance District. He accomplished the disposal of surplus property and materials valued at millions of dollars, with a large return to the government.

After his release by the Ordnance Department early in 1921, Mr. Francis returned to the private practice of consulting engineering, continuing in this until his death.

During his long professional career Mr. Francis was responsible for the design of the heating, ventilating, and electrical systems, and similar engineering features, in such buildings as the Pan-American Union, Folger Shakespeare Memorial in Washington, Indianapolis Public Library, Detroit Museum of Arts, buildings for Duke, Cornell and Princeton Universities, Benjamin Franklin Memorial and Franklin Institute Museum in Philade'phia, Singing Tower at Lake Wales, Fla., Valley Forge Memorial Chapel, and the monumental building in Washington housing the Department of Justice.

At the time of his death Mr. Francis was a special consultant to the Procurement Division of the Treasury Department and mechanical engineering consultant to the Philadelphia Board of Education.

Mr. Francis is survived by his widow, two daughters, and a son, Isaac Hathaway Francis III.

John D. Small

CHICAGO—John D. Small, consulting engineer of this city and member of the ASHVE, died at his home July 5 after an illness of several weeks.

W. Roy Eichberg

PHILADELPHIA — W. Roy Eichberg, founder and head of the Carolina Sheet Metal Corp., Philadelphia, died July 4 at his home in Drexel Hill. He was 47.

A vice-president and former secretary of the ASHVE, Mr. Eichberg was a member of the code authority of the roofing and sheet metal contracting division of the construction industry.

At the time of his death, Mr. Eichberg was serving his second term as president of the Associated Roofing, Metal and Heating Engineers in Philadelphia, and secretary of the Coordinating Committee of the Construction Industry in Philadelphia.

After undergoing a serious operation last fall, Mr. Eichberg never fully recovered his normal strength and vitality.

He is survived by his wife, two young daughters, and two sisters.

WITH THE MANUFACTURERS • • • •

Combustion Engineering Co., Inc., New York, appointed Theodore H. Ross district sales manager (for Pittsburgh) of the industrial stoker division.

Dail Steel Products Co., Lansing, Mich., has appointed W. D. Siemer, Passaic, N. J., sales representative for northern New Jersey, working under the direction of J. G. Stalb, eastern sales director of the company.

R. D. Bitzer and Co., Philadelphia, has been appointed sales representative in eastern Pennsylvania.

Julien P. Friez & Sons, Inc., Baltimore St. and Central Ave., Baltimore, has appointed the General Instruments & Controls Co., 205 West Wacker Drive, Chicago, as its factory representative in that area. General Instruments will handle the Friez line of humidistats, thermostats, recording instruments, and similar equipment for air conditioning and heating.

Hancock Valve Div., Consolidated Ashcroft Hancock Co., Bridgeport, Conn., has announced that Louis H. Brendel has joined the company as assistant sales manager of the Hancock Valve Division. He will assist M. S. Palmer, sales manager, in the promotion and sale of a new line of valves.

For the past two years Mr. Brendel has been an account executive with the Southerland-Abbott advertising agency, and prior to this he spent several years advertising and selling valves and industrial control equipment.

Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, has announced the appointment of the Consulting Engineering Co., No. 1 Terminal Office Building, Pittsburgh, as its sales representative in that territory. J. F. Tutein and T. Grover McCann will have charge of handling its line of gages, industrial instruments, valves, and other heating equipment.

Penn Electric Switch Co., Des Moines, Ia., has announced the removal of its New York office from 33 West 60 Street to 15 Laight Street. The new location was opened July 22. Export headquarters and New York office now are both located at this address. R. V. Clark, manager, and D. A. Coon, sales engineer, continue to represent the company in their New York office, while A. R. Rocke continues as manager at the export office, Leo de Barros as assistant manager, and Douglas Pleasanton as engineer.

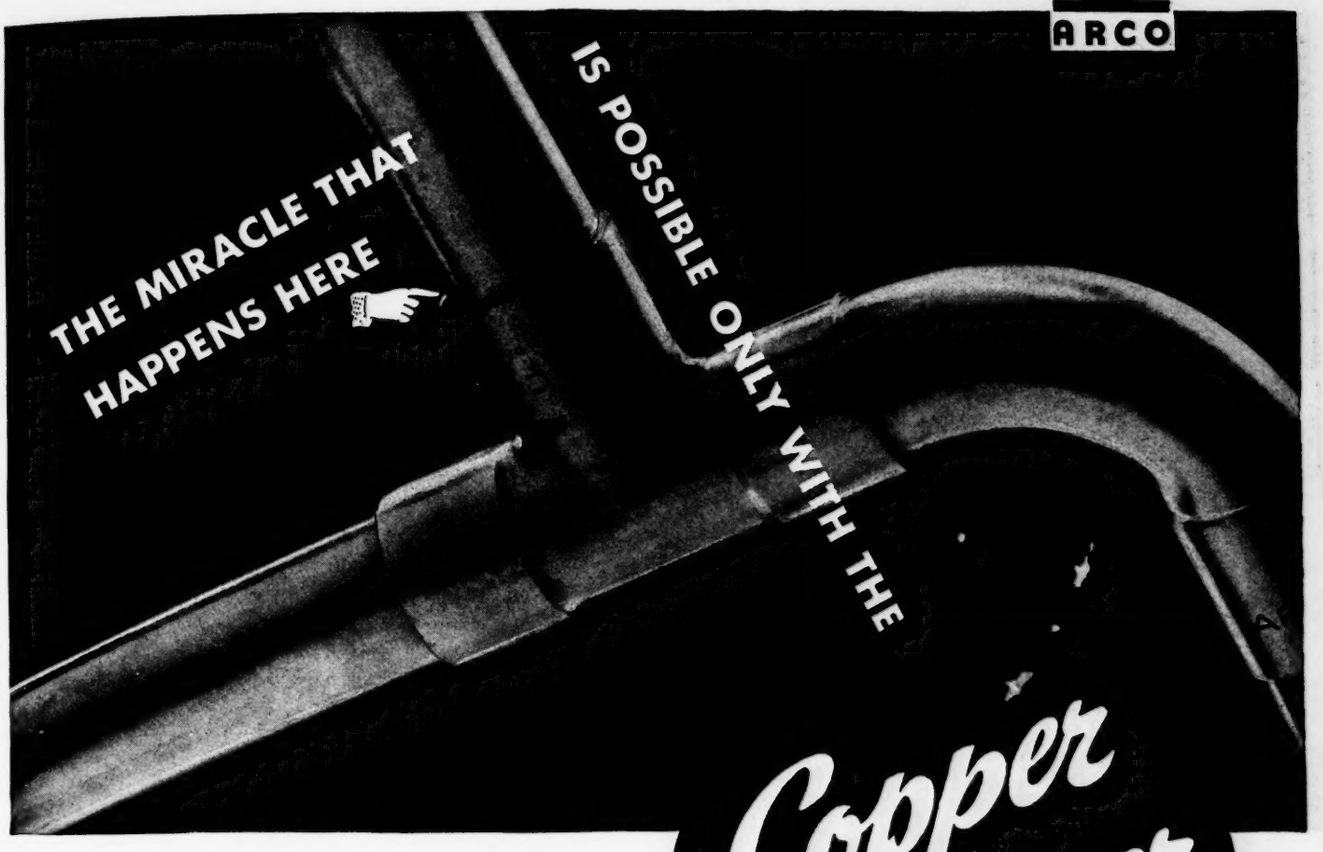
Penn Electric Switch Co., Des Moines, Ia., has announced the naming of K. W. Cash as advertising manager and sales promotion director of that firm, effective July 1. Mr. Cash came to Penn Electric from a post as advertising manager of the C. E. Erickson Co., Des Moines. He was formerly connected with the Gardner Advertising Co., St. Louis, on copy and research, and with the Lessing Advertising Co., Des Moines, as copy writer.

The appointment of Nelson B. Delavan and Ben L. Boalt as vice-presidents, effective July 2, was also made known.

Mr. Delavan, who has been sales manager of the company for the last five years, was named vice-president and director of sales.

Mr. Boalt, who has been in charge of heat control sales for the company for the last four years, was named vice-president in charge of the heat control division.

YOUR JOBBER NOW CARRIES ARCO FULL FLOW FITTINGS IN STOCK



VIBRATION PROOF LEAK PROOF

For Every Heating & Air Conditioning Installation

WHAT happens in the Arco copper to copper joint is the miracle of making a bond that is stronger than the pipe itself... that is absolutely leak-proof and vibration proof...that neither pressure nor weight nor pull can break.

Arco Pipe and Arco Fittings, both being wrought copper, react identically to heat and cold, expansion and contraction. The joint is made at a lower temperature, eliminating the chance of annealing or crystallizing the pipe. The operation is quicker and easier than joining copper to casting. And better: You have *all* the advantages of copper in every section of the line. Pipe *and* fitting are non-porous, corrosion resisting, identical in reaction to every physical and chemical condition.

Especially in air conditioning work, where constant vibration is a factor to contend with, you can do no better than to standardize on the Arco copper to copper connection. If you want the whole story on how it can insure more profitable installations and reduce service calls, write or phone—

COPPER PIPE AND FITTINGS DIVISION
AMERICAN RADIATOR COMPANY
40 WEST 40th STREET, NEW YORK, N. Y.
Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

ARCO

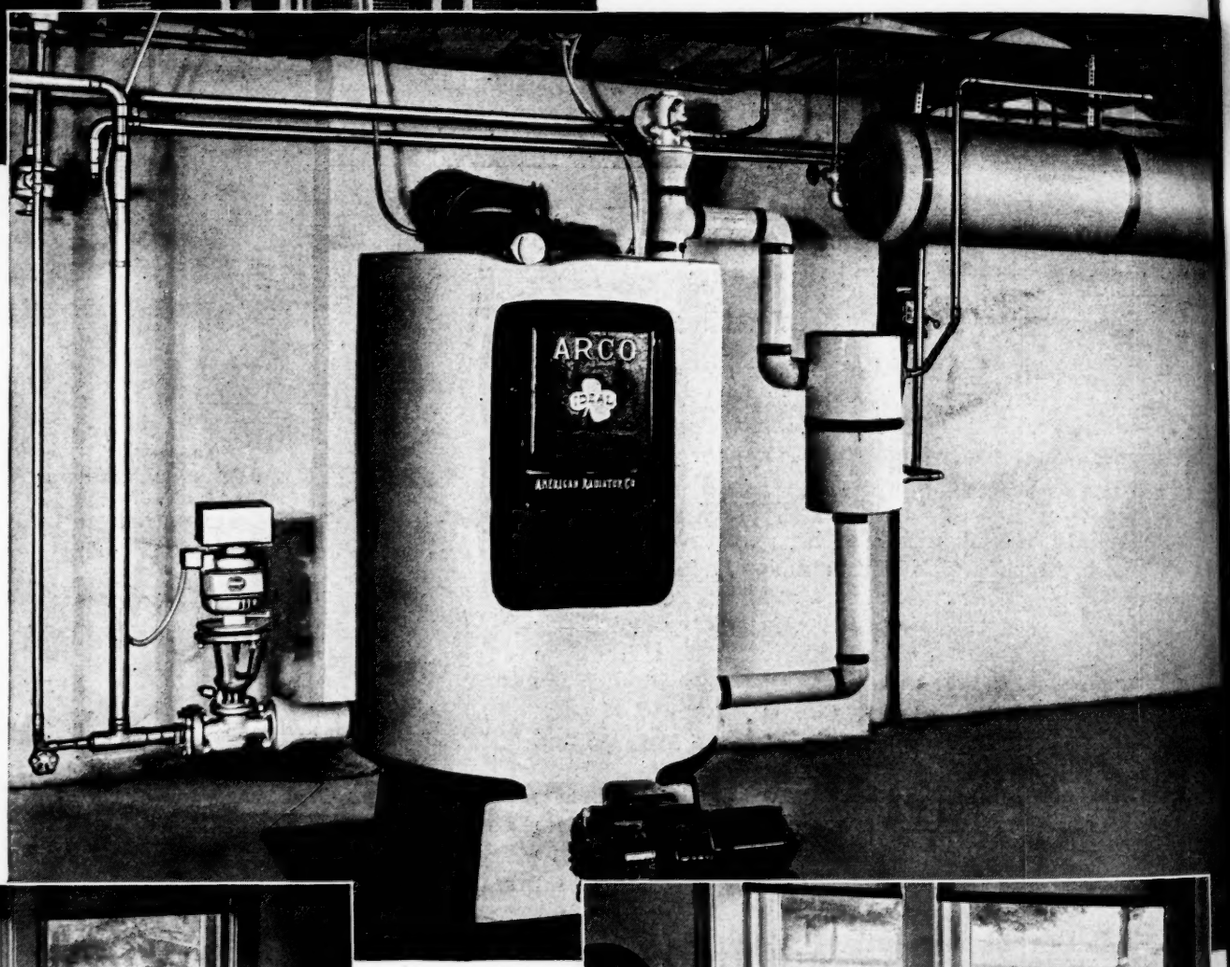
Full Flow

WROUGHT COPPER FITTINGS AND WROUGHT COPPER PIPE

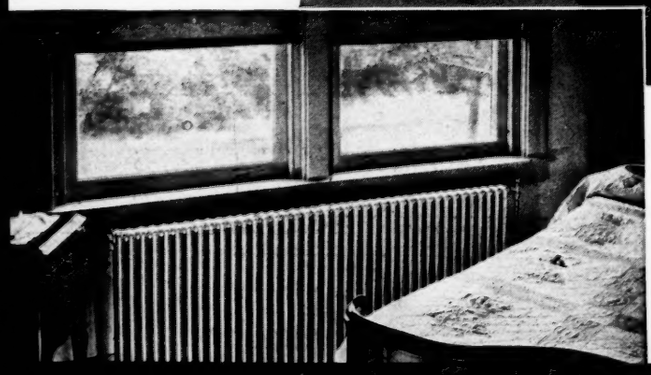
ARCO "all copper"

BELOW—Here is the Arco Boiler W-2506. Note how the Arco Copper Pipe gleams. It has been burnished and lacquered to keep its lustre. What owner could help being proud of this installation!

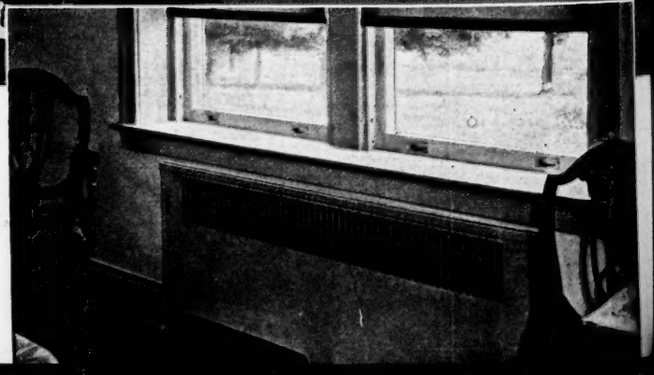
ABOVE—An All-Copper American Radiator Heating System was installed in this home in Lancaster, Pa.



BELOW—Upstairs the slender Arco Radiators assure warmth and comfort.



RIGHT — Arco Convectors bring a modern note to the living room downstairs.



systems bring New Business

• Many Contractors are building up their business with American Radiator Heating Systems and Arco Copper Pipe and Fittings

"LAST YEAR, I determined to build my business by installing only the best heating system for each job. I felt that home owners would be glad to pay a little more to have modern, efficient, carefree heating which would pay them dividends in comfort, convenience and low operating costs. So I started telling home owners of the advantages of a complete American Radiator Heating System with Arco Copper Pipe and Fittings. I specified the best system I could design for every job and I explained the importance of each item in my specification.

"My customers have been glad to pay the additional cost for the assurance of having the best installation possible. This policy has kept me busy for the last two years, because satisfied customers have helped me to sell many other jobs."

That's what one Heating Contractor says who has discovered that there's more to selling heating than just price. Other Heating Contractors have had the same experience. When the best sort of heating system you can install costs just a few dollars more—you'll find there are few home owners who will object to the price when you show them what they're getting.

If you want the complete details of this All-Copper American Radiator Heating System, we'll be glad to send them. Write for the facts about this new way to satisfy customers and build business by installing the best in heating. A postcard or letter will bring full details.

AMERICAN RADIATOR COMPANY

Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

40 West 40th Street, New York, N. Y.

NEW EQUIPMENT

Electric Thermo-Shield Psychrometer

Elimination of error due to heat radiation from surrounding objects, including the operator, is claimed for the Friez electric thermo-shield psychrometer, announced by Julien P. Friez & Sons, Inc., Baltimore, Md. The air sample is drawn through the top, away from proximity with the operator. The initial warmth effect of wet bulb reservoirs is eliminated by individual applications of water to the wet bulb for each reading.

The mechanism is encased in a highly polished chromium-plated thermo-shield equipped with a protective glass window for thermometer visibility and an integral rack for psychrometric tables.

The case is approximately 7 in. square by 13 in. high and is provided with a carrying handle, and sufficient electrical connector to assure portability and flexible operation.

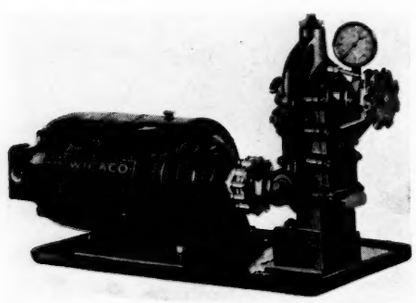
The instrument is recommended for use in laboratories, meteorological observations, air conditioning, refrigeration, and industrial work.

Wicaco Metering Pump

Wicaco Machine Corp., 4801 Stenton Ave., Philadelphia, has placed on the market the Wicaco type C-F adjustable fuel oil pump for use with light commercial and industrial oil burners. It is said that this pump has proven itself efficient in the handling of bunker C or no. 6 fuel oil.

The manufacturer claims that the adjustable feature of the pump eliminates the necessity for any regulating valves, venturi tubes, or viscosity controls. When solenoid or mechanically operated shutoff valves are used, the pump is equipped with an adjustable bypass, which is designed to prevent any undue high pressure building up while the burner is slowing down after the valve has been shut off.

Another feature of the pump, according to the manufacturer, is its ability to raise heavy oil at low temperatures from underground tanks.

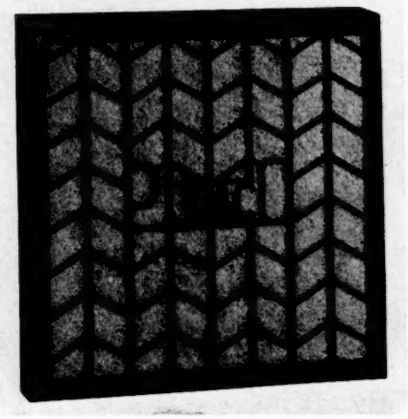


Wicaco metering pump

Plymco Air Filter

Plymouth Cordage Co., North Plymouth, Mass., has announced an air filter of the throwaway type and with a filtering medium of rope fibers. The device is designated as the Plymco air filter.

Advantages claimed for the filtering medium used in the Plymco air filter are light weight, odorless, non-corrosive, and free from objectionable splinters, being composed of clean, strong, flexible rope fibers. A viscous, semi-solid adhesive is used to treat the medium, the fibers being arranged in graduated layers with the intake layer being rendered fire resistant. From the intake side each successive layer is finer than the one preceding it and the fibers on the exhaust side



Plymco air filter

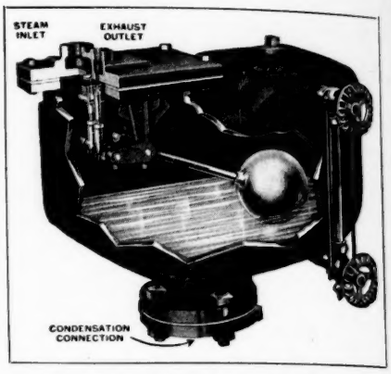
are so closely packed as to resist the passage of pollen, dust and bacteria.

The units with a capacity of 800 c.f.m. at a velocity of 300 f.p.m. vary in resistance from 0.08 to 0.25 in. of water, depending on the type required. They are available in a range of sizes to fit all standard filter frames and can be furnished in four standard sizes all 2 in. thick and with the following areas: 16 x 20; 16 x 25; 20 x 20 and 20 x 25 in.

Lightweight Refractory Concrete

A new type of Firecrete for casting lightweight refractory concrete on the job has just been announced by Johns-Manville, New York. Known as L. W. (or lightweight) Firecrete, this new product is composed chiefly of high alumina clay calcined at high temperatures. The resulting concrete weighs only 75 lb. per cu. ft. Under continuous operation at 2400°, shrinkage is said to be very slight.

The manufacturer claims that it is 40% lighter than firebrick and that it has 40% lower heat storage capacity.



Marsh condensation return trap

Marsh Condensation Return Trap

Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, has recently placed on the market the Marsh condensation return trap which is designed for installation on all types of steam boiler systems.

The trap functions to return water of condensation to the boiler without the use of pumps. It may be used in connection with low pressure heating, process, or industrial installations where the operating pressure is not in excess of 25 lb. It is said that this trap will function on all varying pressures from 25 lb. per sq. in. down to 25 in. of vacuum.

This condensation return trap is entirely automatic in operation and it is claimed that it will require little or no attention over a period of many years of operation.

In service it is installed at a suitable point adjacent to the boiler above the water line. The condensation connection is connected with the lowest level of the return main below the water line. On either side of this latter connection swing check valves are installed. A connection is made from the boiler proper to the steam inlet. The exhaust is then piped away to a stack or other convenient point.

Streamlined Domestic Stoker

Econocol Stoker Division of Cotta Transmission Corp., Rockford, Ill., has announced a domestic size Econocol stoker, streamlined in the modern fashion with all moving parts enclosed.

Two features of the new streamlined design are of interest—first, the hopper is long and low and easy to reach and second, the entire hopper top is open when the lid is raised. Mechanically the stoker is similar in detail to the larger commercial Econocol models. Its low hopper and streamlined enclosure are made of copper-bearing steel. Closing the cover automatically seals the hopper.

Taylor Reset Controller

The Taylor reset controller, recently developed by the Taylor Instrument Companies, Rochester, N. Y., is an outgrowth of the so-called differential controller which has been used chiefly in air conditioning work. The new controller incorporates all of the advantages of the Fulscope control mechanism and can be adjusted to meet a great variety of requirements.

In general, it controls a temperature, pressure, rate of flow, or liquid level, in a predetermined relation to some other temperature, pressure, rate of flow, or liquid level. It can be used on all applications where a fixed differential must be maintained between two variables, one of which is under control; or where it is desirable to change the control point of a process in accordance with a predetermined ratio to a secondary process or condition.

The reset controller employs one complete Fulscope control system and, in addition, an extra tube system, pressure spring or manometer, depending on the application. The Fulscope mechanism and the second actuating or resetting mechanism are separate, yet so interconnected by linkage that any changes which occur in the resetting system are transferred to the Fulscope mechanism as control point adjustments. Both the adjusting and the controlled conditions are recorded.

The adjustable linkage of the reset controller permits control point changes in a variety of ratios between controlling and resetting systems. The value of this ratio is always a constant for any one adjustment of the ratio linkage. The maximum ratio value obtainable with the reset controller is 5 to 1, which means that the control point can be shifted a maximum of 5 units for each unit change in the resetting system.

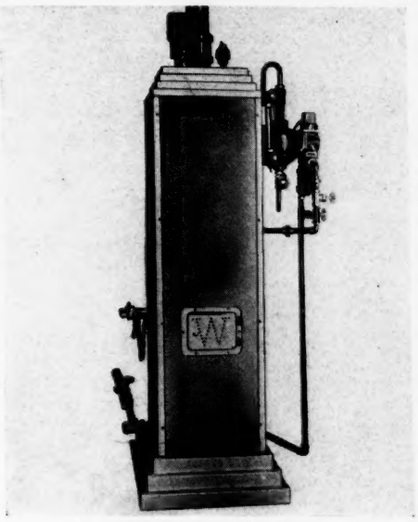
Kaufman Dehydrator

H. J. Kaufman, 4399 Alter Road, Detroit, has announced an air conditioning cabinet for the chemical dehydration of air. The units are available in four sizes with capacities from 200 to 1000 c.f.m.

Kelvinator Condenser Units

Included in the new commercial condensing unit line recently announced by Kelvinator Corp., Detroit, are units designed especially for providing relatively high temperatures for air conditioning, beer cooling, water cooling or milk cooling. The new line consists of 128 condensing units.

Ten standard blocks, a block for every motor size, provide for the new units, which range in size from ¼ to 20 hp.



Walker gas boiler

Walker Gas Boiler

Walker Gas Boiler Co., 3432 Lindell Blvd., St. Louis, has introduced the Walker gas fired boiler, advantages claimed for which include high efficiency, small size with light weight, and reduced manufacturing costs.

The boiler is an all-steel coiled fire-tube type with the tubes spiraling downward. The gas flame is drawn through the tubes at high velocity by means of a fan. A full head of steam is said to be developed from a cold start in a few minutes and before the water at the bottom of the boiler is hot. Tests recently run on a 7½-hp. unit showed the boiler capable of generating 100 lb. pressure in 9 min. and 45 sec., from a cold start, and in 5 min. when the boiler was hot.

Flue gases leave the boiler at 105° to 110°, thus recovering a high percentage of the heat in the flue gas.

The boiler is adaptable to any purpose requiring hot water, high or low pressure steam, for domestic or industrial use, in sizes up to 250 hp.

Electrically Controlled Steam Water Heater

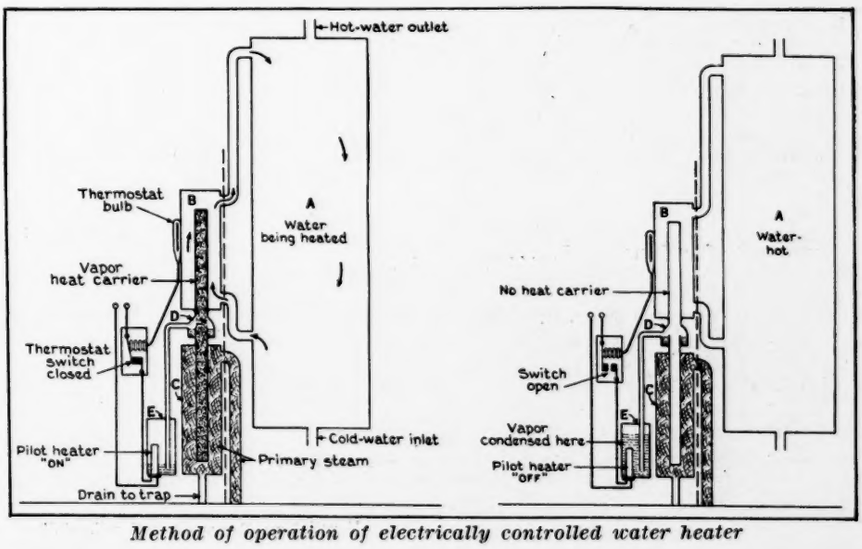
An electrically controlled steam water heater without valves or packing glands has been placed on the market by General Electric, Schenectady, N. Y. Units are available which will heat 75 gal. of water to 160° in 3 hr.

The operation of the heater is unique in that no steam regulating valve is used. The heat is carried from the steam to the water by water vapor.

In the illustration the apparatus to the left of the dotted line is furnished by the manufacturer. The tank, A, is connected, top and bottom, to the water heater, B. The chamber, C, is connected to the steam line and drains through a trap. The vapor tube, D, and attached small heater reservoir, E, contain no air and are hermetically sealed. A small pilot electric cartridge heating unit is located in E. The pilot heater is automatically turned on when the water in A is below the desired temperature, and is turned off when the water reaches that point.

In the illustration at the left the switch is closed and the pilot heater has raised the vapor pressure in E, which has driven the water into D. When the water strikes the surface heated by the steam in C, it is flashed into vapor and goes up against the relatively cool walls at the water end, B. Here, the heat is given up to the water and the condensate runs back down to be revaporized. The cycle is continuous until the water in A has reached the desired temperature.

In the illustration at the right, the switch has opened, and the pilot heater is cold. The tank, E, being outside the insulation, cools, so that the condensate from D is trapped and runs back into E. The heat carrier has now been removed from between C and B, and the water in A is not heated until the thermostat functions again.



Method of operation of electrically controlled water heater

Degree-Days and Unit Fuel Consumption—June, 1935

Also presenting degree-day totals for season of 1934-35; season of 1933-34, and normal totals—September to June, inclusive

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree-days for June, 1935	—	2	—	96	83	75	34	62
Degree-days, season 1934-35, Sept. to June, incl.	2764	4373	2305	6420	6957	6208	4719	5861
Degree-days, season 1933-34, Sept. to June, incl.	2850	4773	2279	6524	7390	6102	5052	6189
Degree-days, Sept. to June, incl., normal season	2890	4533	2352	6045	6822	6290	4703	6155
Lb. coal per sq. ft. rad., June, 1935	—	0.016	—	0.768	0.664	0.600	0.272	0.496
Gal. oil per sq. ft. rad., June, 1935	—	0.001	—	0.066	0.057	0.051	0.023	0.043
Cu. ft. gas per sq. ft. rad., June, 1935	—	0.19	—	9.22	7.97	7.20	3.26	5.95

	Denver	Des Moines	Detroit	Duluth	El Paso	Fort Wayne	Grand Rapids	Harrisburg
Degree-days for June, 1935	60	62	82	273	—	59	87	16
Degree-days, season 1934-35, Sept. to June, incl.	5237	6205	6603	9548	2147	6040	6544	5327
Degree-days, season 1933-34, Sept. to June, incl.	4254	5941	6822	9822	1940	6342	6908	5757
Degree-days, Sept. to June, incl., normal season	5874	6384	6490	9480	2428	5934	6535	5375
Lb. coal per sq. ft. rad., June, 1935	0.480	0.496	0.656	2.184	—	0.472	0.696	0.128
Gal. oil per sq. ft. rad., June, 1935	0.041	0.043	0.056	0.187	—	0.040	0.060	0.011
Cu. ft. gas per sq. ft. rad., June, 1935	5.76	5.95	7.87	26.21	—	5.66	8.35	1.54

	Hartford	Indianapolis	Kansas City	La Crosse	Los Angeles	Louisville	Memphis	Milwaukee
Degree-days for June, 1935	45	44	22	103	5	20	—	130
Degree-days, season 1934-35, Sept. to June, incl.	6132	5166	4644	7331	1287	4061	2740	6997
Degree-days, season 1933-34, Sept. to June, incl.	6508	5489	4369	7123	862	4400	2886	6819
Degree-days, Sept. to June, incl., normal season	6036	5298	4852	7322	1504	4180	2950	7245
Lb. coal per sq. ft. rad., June, 1935	0.360	0.352	0 176	0.824	0.040	0.160	—	1.040
Gal. oil per sq. ft. rad., June, 1935	0.031	0 030	0.015	0.071	0.003	0.014	—	0.089
Cu. ft. gas per sq. ft. rad., June, 1935	4.32	4.22	2.11	9.89	0.48	1.92	—	12.48

	Minneapolis	New Haven	New Orleans	New York	Oklahoma City	Omaha	Peoria	Philadelphia
Degree-days for June, 1935	106	47	—	31	5	60	57	13
Degree-days, season 1934-35, Sept. to June, incl.	7725	5847	948	5293	3132	5743	5776	4759
Degree-days, season 1933-34, Sept. to June, incl.	7604	6257	854	5679	3131	5377	5814	5016
Degree-days, Sept. to June, incl., normal season	7850	5895	1024	5347	3613	6131	6109	4855
Lb coal per sq. ft. rad., June, 1935	0.848	0.376	—	0.248	0.040	0 480	0.456	0.104
Gal. oil per sq. ft. rad., June, 1935	0.073	0.032	—	0.021	0.003	0.041	0.039	0.009
Cu. ft. gas per sq. ft. rad., June, 1935	10.18	4.51	—	2.98	0.48	5.76	5 47	1.25

	Pittsburgh	Portland, Ore.	Providence	Reading	Rochester	St. Louis	Salt Lake City	San Francisco
Degree-days for June, 1935	14	77	75	18	52	14	23	137
Degree-days, season 1934-35, Sept. to June, incl.	5044	4084	6108	5254	6679	4303	5304	2465
Degree-days, season 1933-34, Sept. to June, incl.	5723	3236	6370	5584	7135	4426	3994	2146
Degree-days, Sept. to June, incl., normal season	5235	4469	6014	5389	6732	4585	5555	2876
Lb. coal per sq. ft. rad., June, 1935	0.112	0.616	0.600	0.144	0.416	0.112	0.184	1.096
Gal. oil per sq. ft. rad., June, 1935	0 010	0.053	0.051	0 012	0.036	0 010	0.016	0.094
Cu. ft. gas per sq. ft. rad., June, 1935	1.34	7.39	7.20	1.728	4.99	1 34	2.21	13.15

	Scranton	Seattle	Spokane	Syracuse	Toledo	Trenton	Washington, D. C.	Wichita
Degree-days for June, 1935	31	115	106	37	64	20	—	19
Degree-days, season 1934-35, Sept. to June, incl.	6238	4341	5998	6723	6190	5332	4430	4185
Degree-days, season 1933-34, Sept. to June, incl.	6572	3753	4954	7123	6505	5787	4785	3908
Degree-days, Sept. to June, incl., normal season	6129	4883	6355	6893	6103	4933	4626	4673
Lb. coal per sq. ft. rad , June, 1935	0 248	0.920	0.848	0.296	0.512	0.160	—	0.152
Gal. oil per sq. ft. rad., June, 1935	0.021	0.079	0.073	0 025	0.044	0.014	—	0 013
Cu. ft. gas per sq. ft. rad., June, 1935	2 98	11.04	10.18	3 55	6.14	1.92	—	1.82

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree-Day Handbook."

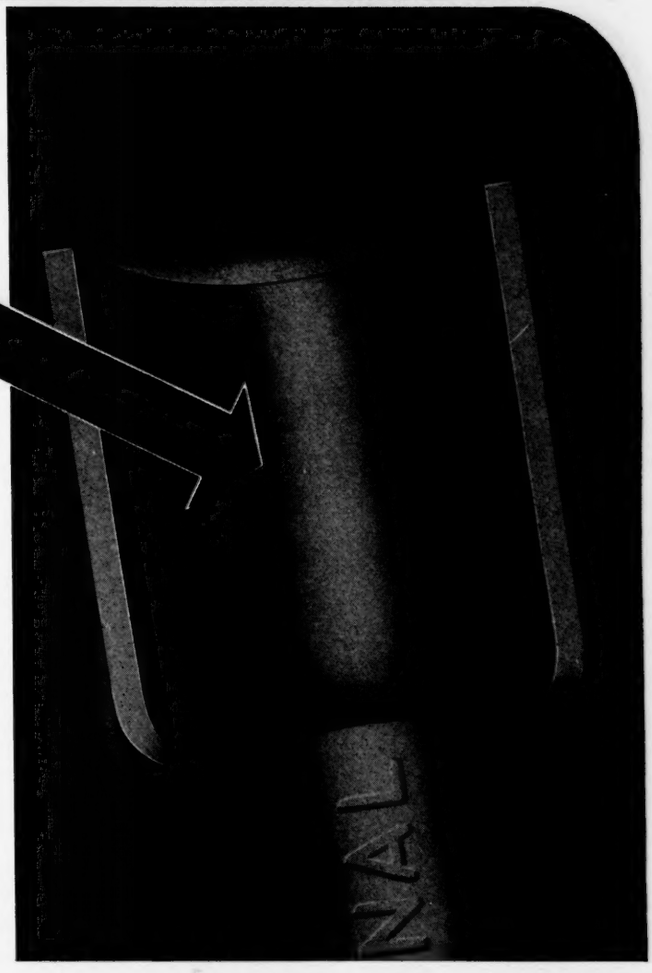
THE RIGHT START FOR A SUCCESSFUL PIPING SYSTEM....

...begin with smooth, clean, scale free pipe

The foundation of successful performance in a piping system lies first, in the intelligent selection of the pipe—second, in good, sound installation practice. It costs no more to use pipe that will assure better performance and greater economy in the long run—pipe that has real practical "plus" qualities, such as the NATIONAL Scale Free and Spellerizing features. A good workmanlike installation deserves to be backed by pipe that will measure up to every expectation of both the installer and the owner. The NATIONAL Scale Free process (applied to butt-weld sizes ½ to 3-inch) and the Spellerizing process (size 4-inch and under) give a real protection against corrosion, while the uniform, strong, ductile steel and good threading qualities of NATIONAL make for easier and quicker time on the job. Consistent use in the plumbing and heating field by discriminating buyers for many years has made NATIONAL Scale Free Pipe—*America's Standard Wrought Pipe.*

NATIONAL TUBE COMPANY • Pittsburgh, Pa.
Pacific Coast Distributors—COLUMBIA STEEL CO., San Francisco, Calif.
Export Distributors—UNITED STATES STEEL PRODUCTS CO., New York, N. Y.

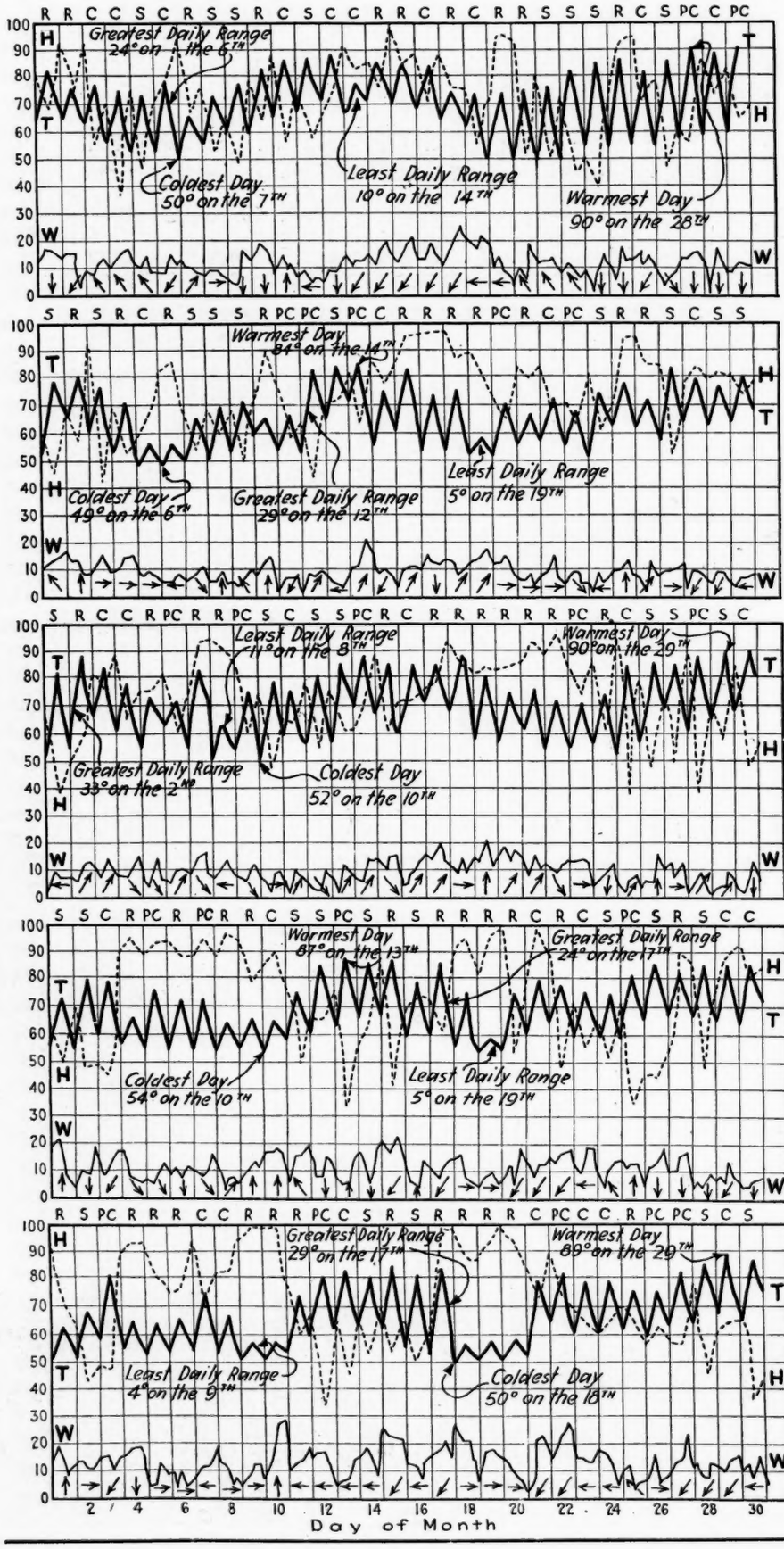
United States Steel Corporation Subsidiary



CHROMATE TREATMENT—*All National Galvanized Pipe is given a special chromate treatment to resist discoloration and the formation of white rust. This patented process preserves that smooth, glistening surface or metallic lustre which is characteristic of good galvanizing.*

THE WEATHER FOR JUNE, 1935

Plotted from records compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


R R C C S C R S S R C S C C R R C R C R R S S S R C S PC C PC
Greatest Daily Range 24° on the 6TH
Coldest Day 50° on the 7TH
Least Daily Range 10° on the 14TH
Warmest Day 90° on the 28TH
S R S R C R S S S R PC PC S PC C R R R R PC R C PC S R R S C S S
Warmest Day 84° on the 14TH
Coldest Day 49° on the 6TH
Greatest Daily Range 29° on the 12TH
Least Daily Range 5° on the 19TH
S R C C R PC R R PC S C S S PC R C R R R R R PC R C S S PC S C
Least Daily Range 11° on the 8TH
Warmest Day 90° on the 29TH
Greatest Daily Range 33° on the 2ND
Coldest Day 52° on the 10TH
S S C R PC R PC R R C S S PC S R S R R R R C R C S PC S R S C C
Warmest Day 87° on the 13TH
Greatest Daily Range 24° on the 17TH
Coldest Day 54° on the 10TH
Least Daily Range 5° on the 19TH
R S PC R R R C C R R R PC C S R S R R R R C PC C C R PC PC S C S
Greatest Daily Range 29° on the 17TH
Warmest Day 89° on the 29TH
Least Daily Range 4° on the 9TH
Coldest Day 50° on the 18TH
T
H
W
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

St. Louis

Mean temp. for month, 71.5°; aver. wind velocity, 9.9 m.p.h.; prevailing direction of wind, S.

Chicago

Mean temp. for month, 65.1°; aver. wind velocity, 8.9 m.p.h.; prevailing direction of wind, W.

Pittsburgh

Mean temp. for month, 70.1°; aver. wind velocity, 9.0 m.p.h.; prevailing direction of wind, SW.

New York

Mean temp. for month, 68.6°; aver. wind velocity, 11.8 m.p.h.; prevailing direction of wind, S.

Boston

Mean temp. for month, 65.5°; aver. wind velocity, 12.5 m.p.h.; prevailing direction of wind, W.

Iron Fireman beats "par"

-declare Cleveland Golf Clubs

This is the story of a new champion at four Cleveland golf clubs. The match—Iron Fireman automatic coal firing vs. high fuel costs. The course—heating plant and club house. The gallery—management and members. The results—

Shaker Heights Country Club, as reported by R. D. Clark, President: "When Iron Fireman replaced hand-fired coal, *annual fuel cost savings were $1130.05, or 45%. We are very well pleased.*"

Acacia Country Club, as reported by Elmer E. Heasley, Jr., President: "Iron Fireman heating has given us plenty of hot water and even temperature at all times *with a 51% reduction in fuel costs.*"

Canterbury Golf Club, as reported by E. B. Roberts, President: "Iron Fireman has given us even temperature at all times. *Fuel costs have been reduced 25%.*"

Oakwood Club, as reported by Robert L. Hays, Secretary-Treasurer. "We installed Iron Fireman four years ago. *It is very economical to operate. We recommend it highly.*"

* * * * * * *

If you pay fuel bills for a building, institution, or factory, you will get the significance of the above performance records of Iron Fireman firing. In these four cases, as in thousands of other installations, Iron Fireman has reduced fuel and firing labor costs, provided steady, even heat, eliminated smoke nuisance.

Your own heating plant would do a better job with an Iron Fireman automatic coal burner installation. And you would have the convenience of automatic heating, plus lower fuel bills. Iron Fireman can be quickly installed. Bin feed or standard hopper models for boilers up to 300 h.p. Convenient payment terms. Write for literature or free firing survey. Iron Fireman Manufacturing Company, Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers everywhere.

IRON FIREMAN

AUTOMATIC *Self Regulating* COAL FIRING

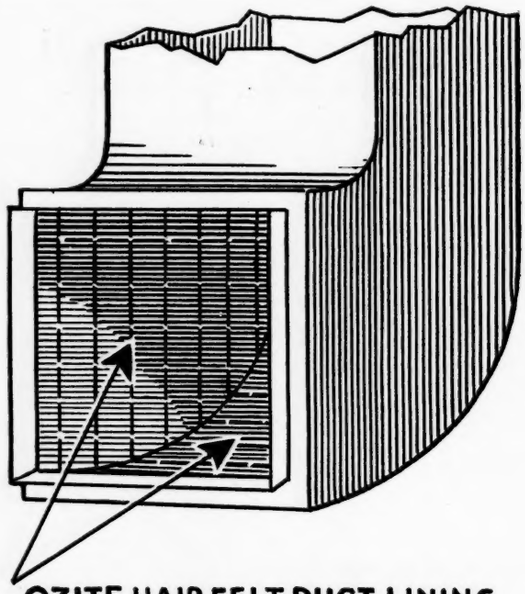
IRON FIREMAN MANUFACTURING CO.
3040 W. 106th Street, Cleveland, Ohio

☐ Please make boiler room survey ☐ Send literature

Name.....

Company.....

Address.....



OZITE HAIR FELT DUCT LINING

Vibration Troubles Vanish

When You Line Ducts with **Ozite**

HEATING and ventilating air ducts which vibrate and rumble with motor and blower noises can be silenced effectively with Ozite Hair Felt Duct Lining.

Made entirely of washed and sterilized cattle hair, Ozite has an unusually high coefficient of sound absorption at the frequencies at which most noises of motor-driven air conditioning equipment occur.

Ozite Hair Felt Duct Lining not only deadens sound and vibration but also insulates against heat and cold. Its thermal conductivity is only 0.246 B.T.U's.

Whether you are modernizing existing air-conditioning plants or building new ones you can be sure of complete freedom from noise and vibration when you use this efficient, moisture-resistant material. Write for full details on Ozite now!

AMERICAN HAIR & FELT CO.
MERCHANDISE MART CHICAGO, ILL.

Ozite
HAIR FELT
AIR DUCT LINING

Air Conditioning Eligible for $50,000 Modernizing Loans

(Concluded from page 37)

Inc., 286 Fifth Ave., New York; D. M. W. Construction Co., 2058 Fulton St., Brooklyn, and Geo. F. Driscoll Co., 548 Union St., Brooklyn.

Air conditioning installations for the U. S. Capitol, and the Senate and House Office Buildings, are in the offing. The approximate cost of these jobs is estimated at $2,500,000. Active preparations are under way, but definite action will be held up pending the authorization of the estimated cost by the present Congress. David Lynn, architect of the Capitol, will be in charge.

Other federal air conditioning jobs include an installation in certain rooms of the old Supreme Court section of the Capitol. This contract was awarded to the Kelvinator Corporation at Washington for $6,681.

Riggs-Distler & Co., Inc., Baltimore, has been awarded the contract for air conditioning the east and west wings of the Administration Building of the Department of Agriculture. The award figure, made on a lump sum bid, was $287,287.

The National Park Service, Department of the Interior, has formally awarded the contract for the installation of air conditioning in rooms 3622, A-3624, and 3624A, Navy Building, Washington, to the Standard Air Conditioning Co., 40 West 40 St., New York. The contract figure is $2,235.

It was planned to condition certain rooms in the State Department Building in Washington and bids were taken, but a recent announcement by the National Park Service states that all bids have been rejected and the project cancelled.

Federal heating job news includes an announcement that a new heating plant will be installed in the post office building at Cairo, Ill. This work will be under the supervision of the Procurement Division of the U. S. Treasury. Bids have been advertised for, and will be opened on August 16.

Duncanson & Tracy, Inc., 13 East 37 St., New York, has been awarded the contract for an improvement to the heating system of the Naval Hospital at Brooklyn. This project is being handled by the New York office of the Bureau of Yards and Docks, Navy Department. The contract figure is $62,500. Work is to be completed in 90 calendar days.

All bids received for the heating system extension in existing shops and storage buildings in the U. S. Experimental Farm at Beltsville, Md., opened at Beltsville, Md., on June 28, have been rejected by the Department of Agriculture. The project is to be readvertised shortly.

An appropriation of $40,000 has been made by the Construction Division of the Veterans Bureau for a boiler house and boiler house equipment for the U. S. Veterans Administration Facility at Bronx, N. Y. Bids, which were opened on July 23, were received from W. F. Schmidt, Dayton, Ohio; Glick Construction Co., New York; C. H. Cunningham & Co., Lynn, Mass.; Refractor Construction Co., Inc., New York; Harry Starkman & Bros., Bronx, N. Y.; Chapman-Kruge Engineering Co., New York; William J. Olvany, Inc., New

York; The English Construction Co., Lowell, Mass., and others. No announcement of the low bidders or of an award has been made as yet.

An appropriation of $85,000 also has been made by the Construction Division of the Veterans Bureau for a boiler house addition, boiler and equipment for the Veterans Administration Facility at Bedford, Mass., with July 30 the date for opening bids.

1900 Tons of Refrigeration for New Interior Building

(Concluded from page 54)

For winter operation the fresh air must not fall below 30% with outside air at 0°, and dry. The minimum fresh air requirements for the auditorium and the cafeteria are required to be as indicated for cooling.

The equipment to be installed must carry the contractor's guarantee that the entire system shall operate without any objectionable drafts or noises. The loudness level of noises entering the rooms through the air outlets, return grilles, or through walls must not exceed 20 decibels in the private offices or 25 decibels in the general offices except at points at a distance of 8 ft. or less from air outlets or air inlets, or at a distance of 12 in. or less from the room wall.

The date originally set for opening bids was July 19. This period was later extended to July 26, and the job placed in one prospective contract to include razing buildings on the site, as well as construction of the building itself. The only separate bids received were for escalators and elevators. The total estimated cost is placed at $11,000,000.

Heating a Large Low-Cost Housing Project

(Concluded from page 22)

point is that in spite of the size of the project only two expansion bends and no expansion joints were used. The reason for this was that due to the shape of the building and the necessity for getting the pipe around such obstacles as transformer rooms there are sufficient right angles in the piping to take care of all expansion.

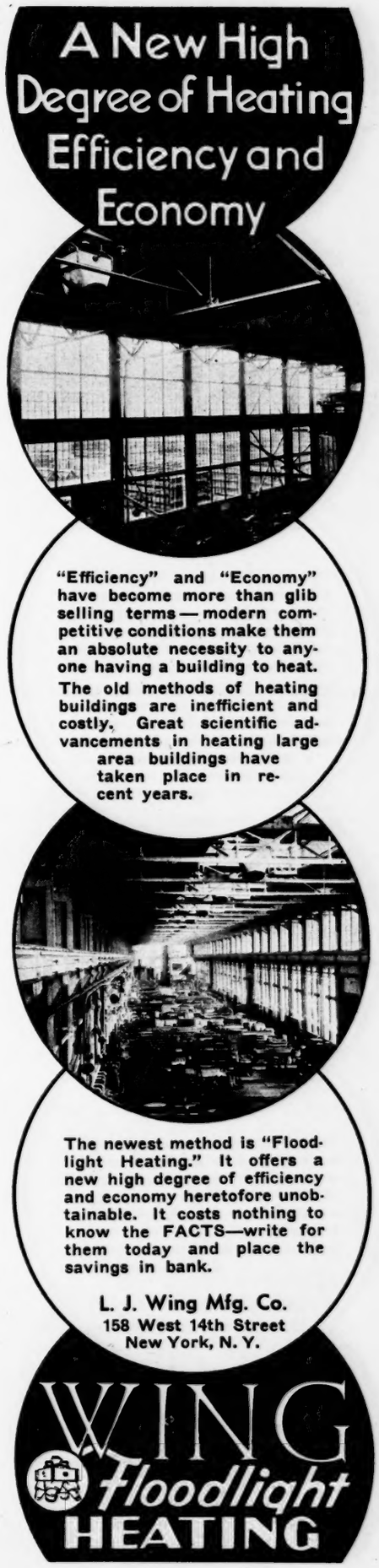
The radiators are direct tubular cast iron, uncovered, and located in most cases below the windows. Piping was welded throughout.

Abstracts

(Concluded from page 58)

in air and dust sampling methods. The third booklet, which is yet to be issued, will deal with some of the economic and legal aspects of dust diseases in industry.

[*"Review of Literature on Effects of Breathing Dusts," by D. Harrington and S. J. Davenport. Bureau of Mines Circular I.C. 6835, part 1. Part 2-A is designated as I.C. 6840. Copies of both circulars are available from D. Harrington, chief, Health and Safety Branch, U. S. Bureau of Mines, Washington, D. C.*]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NEW CATALOGS

American District Steam Co., North Tonawanda, N. Y., has announced the completion of an entirely new edition of its general catalog of Adsco products for steam distribution. This catalog embraces full detailed information on all of the company's numerous lines, such as expansion joints, including a new type of packless expansion joint; steam traps; casing; air valves; cell concrete; multicell tile; condensation meters; storage water heaters; instantaneous and indirect water heaters, and other products. Copies of this new catalog or of individual sections from it may be had by writing to the American District Steam Company.

A. W. Cash Valve Mfg. Corp., 600 North Water St., Decatur, Ill. A folder describing the Cash-Acme F-35 hot water relief valve for furnishing protection against broken boilers. This valve can be used on the city water connection to the hot water heating system or it can be used as an angle relief valve taken off a branch of the hot water return line. A third possible hookup is in the city water supply line between the heating system and the reducing valve in the water line, while a fourth method is in the line between the hot water heating system and the expansion tank. The company has also issued price data sheet no. D-3 describing and illustrating the full line of the company's line of automatic pressure controls for hot water systems, including combination relief and regulator valves, water pressure reducing valves, water regulators, and similar equipment. The data sheet is standard size, looseleaf punched, four pages.

The Fairbanks Co., 393 Lafayette St., New York, has published a well illustrated booklet, catalog 21, describing its line of Fairbanks valves and dart unions. Contains 96 illustrations of various types of valves and unions with descriptions and prices. Fifty-two pages, 6 x 9 in.

Julien P. Friez & Sons, Inc., Baltimore St., and Central Ave., Baltimore, Md. Bulletin A illustrating and describing the company's wall-mounting humidistats. Also Bulletin AT/R featuring the company's relays and control assemblies for use in connection with its other instruments. Both bulletins are standard size, looseleaf punched.

Johns-Manville, 22 East 40 St., New York, has published a 64-page booklet, IN-7A, describing more than half a hundred insulating products, of which there is one for every temperature from 400° below zero to 2500°. The booklet is entitled "Barriers to Industrial Waste." The table of recommendations for insulating materials in this booklet covers heating and power, ovens and dryers, heat treating furnaces, oil refinery, steel mill, non-ferrous smelting, ceramic, gas making, refrigerating and brewery equipment, hot and cold pipes, and other industrial equipment requiring insulation.

The McAlear Mfg. Co., 1901-09 So. Western Ave., Chicago. A 96-page bulletin describing the company's line of regulators for reducing and controlling steam, water, air, gas, and oil pressures. The book includes considerable engineering data and charts, supplemented by blueprints which show applications and roughing-in dimensions of regulators.

W. H. Nicholson & Co., 208 Oregon St., Wilkes-Barre, Pa. Bulletin 635 describing the company's chromium plated welded steel float and welded stainless steel float for steam traps, float valves, and similar equipment. Contains illustrations, specifications, and price data relating to the floats. Standard size, four pages.

C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., has published a striking new industrial thermometer catalog (no. 1125). It contains 24 pages of conveniently arranged listings of the company's complete line of industrial thermometers, miscellaneous metal and woodback thermometers, hygrometers, U-gages, mercurial vacuum gages, and mercurial barometers. Standard size, 24 pages.

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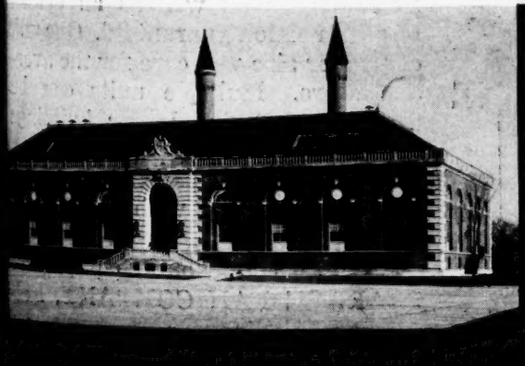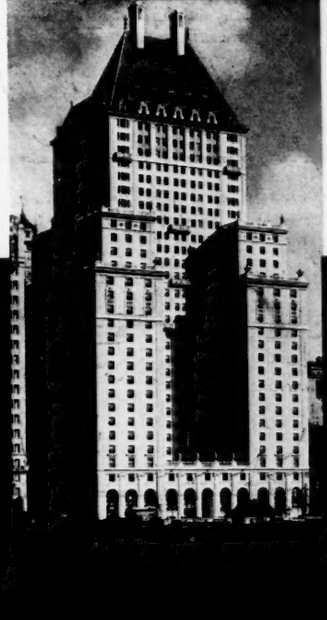
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